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METEOROLOGICAL SUMMARIES OF IMPORTANCE TO AIR POLLUTION IN WESTERN SAN DIEGO COUNTY

George C. Holzworth

California State Department of Public Health
Berkeley, California

31 December 1957

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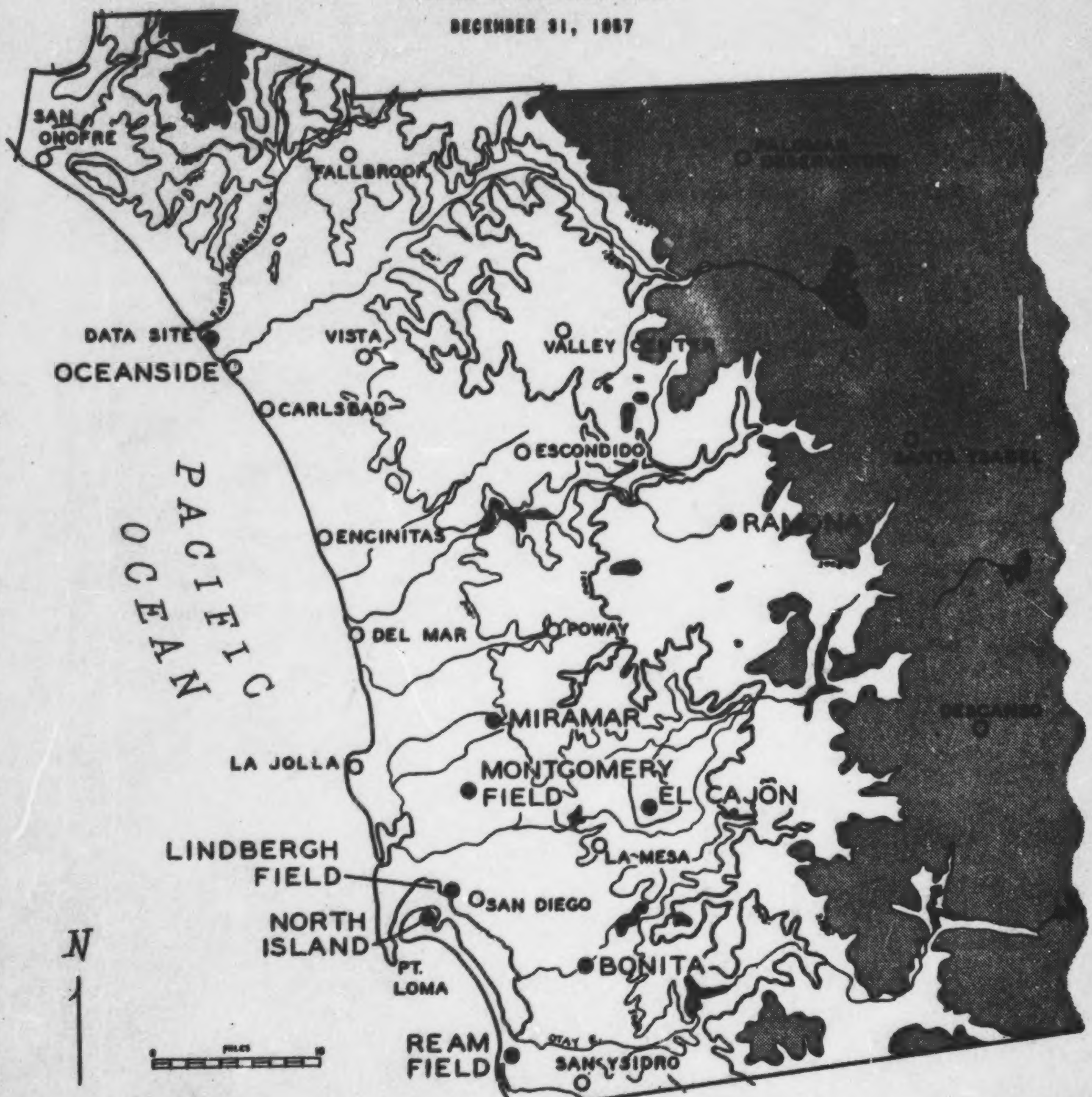
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH
BUREAU OF AIR SANITATION

DECEMBER 31, 1957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METEOROLOGICAL SUMMARIES OF IMPORTANCE TO AIR POLLUTION IN WESTERN SAN DIEGO COUNTY

Prepared by

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on assignment* to the State Department of Public Health

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San Diego County Air Pollution Control District

December 31, 1957

Berkeley, California

Cover: Western portion of San Diego County, showing sites of data sources as solid circles and other locations as open circles. Terrain contours of 500, 1000 and 2000 feet elevation are shown with elevations over 2000 feet shaded.

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[*] Through the U.S. Public Health Service.

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Introduction: San Diego and other cities in the county have experienced eye irritation, elevated oxidant levels and crop damage caused by air pollution. It is believed that at present the San Diego air pollution problem is less severe than that of the San Francisco Bay Area and considerably less severe than that of Los Angeles County. However, because of the rapidly increasing San Diego County population, it is urgently felt by the county that they should make every effort to understand their air pollution problem so that precautionary measures can be planned to prevent the development of a serious problem.

The California State Department of Public Health, Bureau of Air Sanitation, concurs with this attitude. The State has taken an active interest in assisting and advising San Diego County and has made arrangements with the U.S. Weather Bureau and U.S. Public Health Service for the part-time services of the State-assigned Federal meteorologist in the preparation of this report. Other members of the State Bureau of Air Sanitation staff have assisted in this study. San Diego County has contributed to this report by securing a meteorological consultant with long-time professional experience in San Diego. This report has been enhanced substantially by the county meteorologist.

Purpose of the Study: To provide summaries of existing information on characteristics of wind, atmospheric stability and cloudiness, and to describe the manner in which such variables may be expected to affect air pollution in San Diego County. From this information general conclusions will be made as to the times and areas of relatively good or poor atmospheric dispersion. It is also intended that this report will be useful in understanding some of the meteorological factors in San Diego County's air pollution problem and will be of value in planning future studies.

Area: Briefly, the topography of western San Diego County may be described as a vast coastal mesa beginning rather abruptly near the coast at an elevation of 300 feet and extending inland 25 miles. This mesa is cut by narrow and deep river valleys and canyons which drain westward toward the sea. Inland from the coast

30-40 miles, mountains rise to 4000-6000 feet.

Fortunately, much of the available meteorological information is for sites near San Diego City and along the coast and coastal mesa where most of the county population is centered. This area to be covered, then, is the coast and coastal mesa of San Diego County inland to, roughly, 25 miles where the terrain becomes more irregular and mountainous.

General Considerations: Meteorological factors have been considered in relation to urban area-wide air pollution problems as differentiated from smaller scale point source problems. This distinction is made because often the two problems must be treated differently under the same atmospheric conditions.

Contaminants emitted to the atmosphere are dispersed horizontally and vertically, depending on the wind and atmospheric stability. Light winds and stable atmospheric conditions near the ground are conducive to high concentrations of air pollutants. Except in special cases, both factors are necessary; neither by itself is sufficient to bring about excessive air pollution. Where photochemical reactions occur among air pollutants, the availability of sunlight should be considered also.

The most obvious effect of the wind is to establish the direction in which pollutants are carried and the amount of air in the horizontal that is available for diluting emissions. The wind also causes vertical and horizontal mixing through mechanical turbulence. Such turbulence results from roughness of the ground and depends on stability of the air.

The stability of the atmosphere is important in determining to what extent pollutants may be dispersed vertically. Stability can be defined as that property of the atmosphere which tends to return a parcel of air to its original level after a slight vertical displacement. If the atmosphere is unstable, the parcel continues to move in the direction of displacement. During less stable conditions pollutants are more readily mixed and carried aloft. For pollution purposes, atmospheric stability is largely determined by the lapse rate which is simply the decrease of temperature with altitude. In the lower few miles of the atmosphere the lapse rate averages about 2.1° C or 3.5° F per 1000 feet. Near the earth's surface, in the lower few thousand feet, the air temperature frequently increases with altitude. This is called a temperature inversion as the lapse rate is inverted. Such conditions stabilize the atmosphere.

If displaced upward, air parcels continue to rise through the surrounding atmosphere when their temperature is higher, and therefore density is less, than the environment at the same level. As air parcels rise they expand and cool due to reduced atmospheric pressure. If not saturated with moisture, the parcels cool at the rate of 3.3° C or 5.4° F per 1000 feet. From this it is seen that a parcel rising to the level of a temperature inversion suddenly finds itself in an atmosphere that is warmer and less dense than the parcel itself. As a result continued upward motion is inhibited and vertical mixing is confined to the air layer beneath the inversion.

It should be pointed out that mixing is the result of both ascending and descending motions. For parcels that are displaced downward the effect of stable and unstable atmospheres are to restrict and favor, respectively, continued downward motion. This is the same effect as for parcels displaced upward. Also, the cooling rate due to reduced pressure, mentioned in the preceding paragraph, is in addition to cooling of the parcel by mixing with the surrounding cooler atmosphere.

It has been shown (20)* that on clear, nearly calm, nights surface temperatures over city areas are often significantly warmer than over the nearby open country. It was further demonstrated that this temperature differential also extends vertically, and that surface-based inversions over open country are often replaced over cities by much less stable conditions to about three times roof-top heights. While it is believed that such an urban effect occurs at most places, the magnitude is expected to vary with local characteristics, especially city size. As a result of this city effect, during night and early morning pollutants sometimes occur in layers near the base of the urban inversion. During the day surface turbulence and mixing beneath the inversion are usually sufficient to distribute pollutants throughout the air volume beneath the inversion.

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* Numbers in parentheses refer to bibliography.

Winds: Surface winds over western San Diego County exhibit the same general characteristics as the winds along the entire Southern California coast (1, 2, 3). Such air flow shows seasonal variations upon which are superimposed daily land- and sea-breeze effects. Warm season winds blow from sea to land with a reversal during the cold season. Such winds are a natural consequence of the large-scale weather factors determining climate. The daytime sea-breeze and nighttime land-breeze result from greater heating and cooling of the air over land as contrasted with only very slight diurnal changes in air temperature over the sea. In summer the large-scale meteorological features favor the daytime sea-breeze and oppose the nocturnal land-breeze, while in winter the large-scale features have the opposite effect.

Summertime winds show considerable day-to-day regularity in comparison with winter when traveling storms frequent the county. During such stormy periods the winds are usually southerly and rather strong, different from the pattern that will be described. Another feature that deviates from the usual air flow pattern during the cooler times of the year is the "Santa Ana" (see 9). This is a dry, comparatively warm northeasterly wind whose occurrence is somewhat related to the large-scale meteorological factors associated with the land-breeze. In funneling through passes these winds sometimes attain destructive velocities. This is particularly true in Los Angeles and surrounding areas. Santa Anas frequently occur over the mountainous back country of San Diego County where, locally, speeds may be reached that are exceeded only by the most severe mid-winter storms. However, it is seldom that such strong Santa Anas are experienced along the San Diego County coast.

The details of diurnal and seasonal air flow at Miramar, North Island and Ream Field Naval Air Stations are depicted by figures 1-36 (4) which graphically describe the hourly winds on a monthly basis. While the prevailing direction is indicated in these figures, the general air flow can be more fully described by the most frequent directions that occur each hour, and which together total more than 50 percent of all directions for each hour. The fact that these directions are usually clustered together within a small sector of the compass is evidence for the relative constancy of direction. The next most frequent directions are very often adjacent to the directions shown. At the same time there usually are submaxima from other directions, but these seldom occur more than a small percent of the time. It should be remembered that winds are to be expected from any direction, but that for given times there are certain directions that may be expected more frequently than others.

It will be noticed on figures 1-36 that the most frequent directions usually are more variable at the times the wind is shifting from one general direction to another, just after sunrise and near sunset. But this variability sometimes occurs at other times. Occasionally this is due to the fact that of the most frequent directions shown on the figures, two or even three occurred with equal frequency, and so all are plotted; even though just one of these directions, when added to the other most frequent directions, would have been sufficient to meet the criteria of more than 50 percent of all winds. In addition there were a few times when the prevailing direction occurred equally from multiple compass points. In such cases all are indicated as prevailing. On figures 1-36 note that all speeds less than 3 knots, including zero, are listed as calm. This is because the instruments are not sensitive enough to measure such low speeds. However, it is very likely that most of the directions for speeds of 1 and 2 knots would be from the directions shown at those and adjacent hours. Throughout this report, speeds less than 3 knots are sometimes referred to as "calm winds".

Also shown on figures 1-36 are the characteristics of wind speed for all directions. These are illustrated as the percent of time wind speeds are in given ranges and are less than given values. The effect of wind speed alone is such that the less the speed, the longer an air parcel remains over sources and is subject, therefore, to greater amounts of pollution. The critical wind speed leading to excessive air pollution varies with several other factors which are themselves variable, and so is not easily determined. Experience of the Los Angeles County Air Pollution Control District has led them to conclude that an average wind speed of 5.0 mph (miles per hour) or less between the hours 0600 and 1200 satisfies the wind speed criteria for development of air pollution. During the Donora disaster wind speeds were very often less than 5 mph (5). Generally, it can be assumed that the occurrence of excessive air pollution is related to wind speeds of about 5 mph or less.

As pointed out previously, the general air flow over all of the Southern California coastal region is quite similar. That this is true over western San Diego County is shown by the wind similarities between sites in figures 1-36. However, certain differences due to local effects are apparent between sites and are mentioned in the discussion of wind conditions at each site.

Naval Air Station, Miramar is located 10.5 miles north-northeast from Lindbergh Field. It is at 475 feet elevation on an open mesa that very gently slopes down to the west-southwest. To the east-northeast the terrain slope becomes more abrupt and reaches an altitude of 700 feet and higher in about 2.5 miles. The heads of some canyons terminate nearby, but in the immediate vicinity of N.A.S. Miramar they are comparatively shallow. So situated this site is generally representative of conditions over the open mesa.

Figures 12, 1 and 2 for December, January and February show wind characteristics that are typical of the cold season. At this time of the year the nocturnal land-breeze, from the east, is most in evidence. Such directions occur in response to the large-scale meteorological features and local effects that prevail during this season. An example of the former is the pressure pattern, while the latter is exemplified by nocturnal cooling of air in contact with higher and cooler terrain. As this air is cooled it becomes more dense than the surrounding atmosphere and drains toward lower elevations. Thus at Miramar and in other areas of similar topography, downslope winds occur at night during the cold season. Such winds are readily channeled by valleys and canyons. Figures 12, 1 and 2 show that the land-breeze is associated with speeds of 3-7 knots approximately 70 percent of the time, and speeds are less than 8 knots 80-90 percent of the time. Since land-breeze speeds below 3 knots generally occur less than 20 percent of the time, and together with easterly directions account for more than 50 percent of all nighttime winds, easterlies then occur more than 30 percent of the time.

During December, January and February the diurnal sea-breeze, which results from heating over the land, does not often become established until afternoon when it occurs as a wind from the W, WNW, or NW directions. Although of shorter duration than the land-breeze, the sea-breeze is associated with higher speeds. Near 1400 and 1500 PST speeds exceed 7 knots about half the time. Speeds less than 3 knots occur during the afternoon only for a very small portion of the time, roughly 5 percent. This condition is often a continuation of calm or very light winds of the same morning.

The approximate mean times of sunrise and sunset on figures 1-36 show that during the cold season the shifts from land- to sea-breeze and vice versa begin about 2 hours after sunrise and near or just before sunset. The switch from land- to sea-breeze takes most of the forenoon. This is shown on figures 12, 1 and 2 by the increased frequency of calm winds and the variability of direction as the wind shifts. During the evening the switch from sea- to land-breeze also results in variable directions. These shifts tend to occur in a clockwise manner.

Figures 7-9 for July, August and September are all very similar and representative of the warm season. At this time of the year, in contrast to the cold season, there is no indication of the land-breeze. It has been replaced mostly by calm winds (0-2 knots). Through the hours 2200-0800 PST, speeds less than 3 knots occur 40-50 percent of the time, and speeds exceed 7 knots very infrequently. As indicated by figures 7-9 those directions which do occur most frequently at night, from the NNW and NW, are continuations of the strong daytime sea-breeze.

The sea-breeze is well established by early afternoon and is associated with considerably higher speeds than winds at night. Through the hours 1100-1700 PST, speeds less than 3 knots occur very seldom. During the hours 1200-1500 PST, speeds exceed 7 knots more than half the time. In the warm season, while there are some variations, the conditions described by figures 7-9 may be expected to occur with great day-to-day regularity. In particular, easterly winds during a summer afternoon are extremely rare.

Figures 3-6 for March through June depict wind conditions during the warming season. Actually, March is quite similar to the cold season months except that the land-breeze is more variable and nighttime calm winds become more frequent as daytime speeds increase. These general changes continue through April and May to June, which is much like the warm season months. However, in June there is still a trace left of the land-breeze at 0400 and 0500 PST, and the frequency of nighttime calm winds is somewhat less than in summer.

The transitional cooling season is shown best by October and November, figures 10 and 11. In certain respects October is similar to the warm months - calm winds occur at night about 40 percent of the time and the sea-breeze carries over well into the evening. However, a noticeable difference is the appearance of the land-breeze and although these easterly winds do not prevail, this feature makes October somewhat similar to the cold months. By November, figure 11, easterlies prevail and the land-breeze is well established. November is very similar to winter months, except that the frequency of calm winds at night is higher than during the cold season.

Naval Air Station, North Island is located 2.5 miles south-southwest from Lindbergh Field and is at 24 feet elevation. It is virtually surrounded by water. To the west, Point Loma 300-500 feet high, forms a barrier to the winds. The mesa to the east, upon which the city is built, also affects the winds at times.

The cold season here is best depicted by wind conditions during November, December, January and February, figures 23, 24, 13 and 14. The nocturnal land-breeze as such is not evident. However, southeasterly nighttime winds result from drainage down the slopes of the mesa to the east and nearby valleys that drain into San Diego Bay. As this air reaches the water, it spreads out and some of it moves northward following the bay. At North Island these winds are from the SE. Although not shown on the figures, the next most frequent nighttime directions are ESE and E. The Pt. Loma Peninsula is effective in channeling this air flow, which then turns in a counterclockwise fashion and passes out of the entrance to San Diego Bay as a northerly wind. It is not likely that during the night this air is often recirculated back into the southern part of the bay because drainage down the canyons there is from the east. However, during late forenoon and early afternoon, when the sea-breeze begins and speeds are still relatively light, the same air may then be carried back inland.

In the cold season nighttime speeds are very light as this site is protected by the topography from direct easterly and stronger drainage winds. Speeds less than 3 knots occur 40-50 percent of the time, and speeds are less than 8 knots 90 percent of the time. During the day, the sea-breeze is similar to that at the other sites. Because this station is nearer the shore the sea-breeze becomes established about an hour earlier here than at Miramar. At North Island the sea-breeze is most often from the WNW, NW, or NNW directions. It is likely that Pt. Loma acts as a barrier to such winds when they are light. Winter sea-breeze speeds are seldom less than 3 knots, and for a few hours during the afternoon speeds exceed 7 knots about 60 percent of the time.

Warm season conditions, July, August, September, as shown by figures 19-21, do not show the nighttime drainage pattern that exists during the cold months. Instead, the daytime sea-breeze carries over during the night as a light wind from the NW, NNW, or N. Apparently these directions are associated with winds blowing over Mission Bay and reaching North Island across the low terrain separating Mission Bay and San Diego Bay. Nighttime speeds in this season are below 3 knots 30-35 percent of the time. Although this frequency is less than during winter, winds under 8 knots prevail 95 percent of the time.

The daytime sea-breeze is best developed during summer and is most often from either NW or WNW. Throughout the hours 1200-1500 PST speeds may be expected to exceed 7 knots 75 percent of the time. Speeds under 3 knots are very rare during the hours 1000-1800 PST. Figures 19-21 indicate that evening sea-breeze speeds decrease gradually, while forenoon speeds increase more rapidly.

Wind characteristics during the warming season, March through June, are transitional between winter and summer and are shown in figures 15-18. March is much like the cold season, while June is similar to the warm season.

From wind considerations the cooling season is best indicated at North Island by October, figure 22, which shows wind characteristics that are similar to both winter and summer.

Naval Air Station, Ream Field is located 1.5 miles south of San Diego Bay and one mile from the ocean at an elevation of 23 feet. It is on flat terrain that is formed by the junction of the broad mouth of the Tia Juana River Valley, which drains from the east-southeast and southeast in Mexico, and the narrower Otay Valley which drains from the east. Winds at Ream Field are markedly influenced by these valleys. Unfortunately, wind observations throughout the night were made too infrequently to be shown on figures 25-36. Therefore, it is necessary to infer nighttime conditions.

The cold season is represented by November, December, January and February, figures 35, 36, 25 and 26. Although the daytime sea-breeze is comparatively strong for winter, it is apparent that at night the land-breeze is also well developed. Actually, these nocturnal E and ESE winds are associated with air drainage down the nearby valleys. It is believed that 70 percent of these winds are less than 8 knots. Speeds under 3 knots throughout the night may be expected something less than 20 percent of the time. During afternoons, when the sea-breeze is best developed, speeds less than 3 knots may be expected only about 5 percent of the time. Speeds of 8-12 knots occur about 50 percent of the time, except in December when they are somewhat less frequent. At Ream Field the shift between day and night wind regimes occurs rather quickly.

Warm season wind conditions, represented by June, July and August, are shown in figures 30-32. It is believed that easterly winds seldom occur during this season, but that the sea-breeze usually continues well into the night at low speeds. Nighttime speeds under 3 knots are estimated to occur about 30 percent of the time. In the day the sea-breeze comes most often from the W and WNW directions and is most frequently associated with speeds of 8-12 knots. Throughout the hours 1100-1500 PST, speeds usually exceed 7 knots more than 80 percent of the time.

The warming season is represented by March, April and May, figures 27-29. The most obvious feature on these figures is the increase in duration and strength of the sea-breeze. Concurrently, the nighttime easterlies decrease.

Wind conditions during the cooling season are represented by September and October, figures 33 and 34. Although the sea-breeze is still quite strong and extends well into the evening, easterlies are present near sunrise.

Lindbergh Field at the northern end of San Diego Bay is at 19 feet elevation. To the north through southeast the terrain rises rapidly. Wind data from this site are similar in most respects to those for North Island, which is only 1.5 miles to the southwest.

Figures 37 and 38 show the hourly wind speeds for July and December. Although the speed increments and units are slightly different from those for North Island, comparison shows the similarity of speed conditions. At many places absolute calm does not occur nearly so often as the light speeds with which it is sometimes grouped. At Lindbergh Field calm (zero speed) is tabulated separately in figures 37-38. These figures show that absolute calm constitutes only a small portion of all speeds below 4 mph.

The summary used for Lindbergh Field (6) does not include directions by hour of day. However, a monthly summary is included and July and December are reproduced in table 1. During July the westerly sea-breeze is very apparent, and easterly directions occur only a small portion of the time. Although from the west, the sea-breeze at Lindbergh Field often has a southerly component as compared to a northerly component at North Island. During December, northerly and easterly directions frequently occur at night. These directions are often associated with winds that drain toward and spread out over San Diego Bay. Nocturnal easterly winds at Lindbergh Field often continue to follow the bay, are channeled by the Pt. Loma Peninsula and move southward through the entrance to the harbor. Nighttime drainage winds from the N sometimes shift and become easterlies as they reach the bay.

It will be noticed in table 1 that the average speeds with directions N through SE are considerably less than from other directions. This is partly because of the protecting topography to the north and east, and also because drainage winds here are usually light.

Oceanside. A monthly summary of hourly winds for Oceanside (7) is also available. These observations were made just north of the town, 0.5 miles inland and near the mouth of the Santa Margarita River Canyon. The elevation of this site is 18 feet. Because of the nature of the observations the reported wind directions were strongly biased toward the eight primary directions. This has been corrected by the "odd-even" method (8). The top portion of figure 39 shows the percent frequency of occurrence throughout the year of the sea- and land-breeze, and of speeds less than 4 mph. The sea-breeze is represented by the two most frequent summer directions, WNW and W. shown as open circles. Land-breezes or drainage winds are represented by the most frequent winter directions, ENE and NE, shown as x's. Speeds under 4 mph are indicated as solid circles. From the top diagram of figure 39 it is seen that wind conditions here are much like those at the other sites discussed. During winter there is a high frequency of easterly winds and relatively few speeds of less than 4 mph. It is inferred that these easterlies are mostly nocturnal winds that drain down the Santa Margarita Canyon, and that the afternoon sea-breeze usually springs up for a short time. During summer the westerly sea-breeze is predominant, and speeds less than 4 mph often occur. These light winds usually take place at night as the strong daytime sea-breeze diminishes.

The lower diagrams of figure 39 show the complete monthly direction summaries for July and December, typical of the warm and cold seasons. It will be noticed that there are a few directions for which no percent frequency of occurrence is given. This is because in the original tabulation of biased observations, these directions were listed as occurring less than 0.5 percent of the time and could not be accurately corrected. Actually, such directions should be expected about 1-3 percent of the time.

A summary of general wind conditions indicates that the sea-breeze normally occurs coincidentally with higher temperatures, as experienced during afternoons. In the warm season it often continues throughout the night. The sea-breeze frequently is associated with up-slope and up-valley winds that continue to move the air across the county towards the east and south. In all seasons, westerly winds attain significantly higher speeds in the afternoon than during the night and forenoon.

The land-breeze (or drainage wind) occurs coincidentally with lower temperatures. It usually is present at night during the cold season, but seldom, if at all, during the warmer months. This wind is shallow (usually a few hundred feet deep, whereas the sea-breeze depth is often 1000 feet or more) and is characterized by relatively low speeds. Such air flow is effectively channeled by topographical features.

Most of the air reaching San Diego County has passed over the ocean immediately to the west and before that over the Pacific to the northwest. This is the air flow pattern over the Southern California coastal waters described by the U.S. Navy (9), and is based on prevailing wind summaries by one degree longitude-latitude squares over the water. This same general pattern prevails during all seasons. Additional evidence of this pattern may be obtained from wind observations made at San Nicolas, San Clemente and San Miguel Islands (4,7).

The marine air flowing into the coastal region generally moves eastward across the land. Such flow results from the large-scale pressure pattern prevailing during summer and from local effects of heating during the day. Air contiguous to valley sides or mountain slopes is heated during the day by contact with the hot surface. The temperature of the free air at the same elevation changes little since the atmosphere absorbs a relatively small amount of radiation. As these temperature differences result in density differences, the slope air rises and the free air moves in to take its place. This causes air to flow up the slopes and valleys. Thus the transfer of air that has been over lower terrain is favored by valleys and mountain slopes. The sea-breeze often merges with such valley and slope winds to produce conditions favorable to more rapid ventilation of the coastal mesas and canyons.

At night, and especially during the cold season, valley and slope winds are reversed or become very light. As described previously for Miramar, cooling occurs along the slopes and this denser air drains toward lower terrain. Except where unusual topographical features occur, nocturnal drainage winds are usually quite light and shallow. It is partly this nocturnal reversal of air flow associated with low speeds that results in some quasi-basins being described as "confining".

Figure 40 is an idealized representation of a typical valley circulation. This diagram (after Defant) is taken from (10, pp. 662-667 and 11, pp. 20-21) which references also contain more detailed descriptions of mountain-valley and valley-slope wind conditions.

A special wind persistency tabulation for Lindbergh Field very kindly has been made available by the Meteorology Section, Robert A. Taft Sanitary Engineering Center of the U.S. Public Health Service in Cincinnati. This group developed the particular method of tabulating.

The tabulation, based on five years of record, is summarized by months and furnishes information on the frequency of persistence of speeds by number of consecutive hours. These data are shown in table 2. Winds are tabulated for speeds equal to or less than 0, 3, 7 and 12 mph. Persistence is indicated by the number of consecutive hours (shown in table 2) that the above wind speed conditions were satisfied. An end-to-end counting method is used. Take, for example, a series of 11 hourly observations (winds over a period of 10 hours) where the wind did not exceed 7 mph. Such an example would contain one series persisting for 9 hours (1 hour left over), one for 6 hours (4 hours left over) and three for 3 hours (1 hour left over). The greatest number of hours of persistence also given in the tabulation. Each case of persistence is listed for the month in which the series began.

Table 2 indicates that in five years the greatest number of hours that absolute calm persisted was 14, during February. The next greatest number was 9 to 11 hours, also in February, and this occurred only once. The frequency of "2" under the column for 9 hours includes one period of calm for 9-11 hours as well as the one case of greatest persistency, 14 hours. During summer the longest sustained period of calm is only 2 hours. Absolute calm does not often persist for very long.

Speeds equal to or less than 3 and 7 mph are considerably more persistent during the cold than the hot season. That this should be anticipated is indicated by figures 1-38. Since nighttime speeds are usually low throughout the year, greatest persistency of such conditions is expected during winter when daytime speeds are more often low. There is also a weak tendency for speeds equal to or less than 12 mph to be more persistent during winter. However, such speeds are seldom exceeded.

The original tabulation also contains a persistency tabulation of directions for all speeds. This summary indicates that lowest persistency occurs with easterly directions in all months. Greater persistency of direction occurs during summer.

Stability and Temperature Inversions: The dispersion of emissions in stable and unstable atmospheres has already been mentioned along with temperature inversions. Pronounced stable conditions are associated with temperature inversions and less stable conditions with the absence of inversions. Vertical dispersion of emissions is retarded near the inversion base (that point above which temperature increases with elevation). Thus, the vertical mixing of pollutants is confined to the air beneath the inversion base. Actually, this is only generally correct. For instance, with an inversion base at the surface and calm winds, it is obvious that the amount of air available for diluting purposes is not zero. Under such conditions some mixing occurs, but is greatly retarded. However, we shall proceed here on the premise that the vertical column of air available for mixing is approximately determined by the inversion base height. For more detailed descriptions of the behavior of emissions under various stability conditions the reader is referred to (11, pp. 59-61).

Like the wind, the critical inversion base height leading to excessive air pollution varies with several other factors which are also variable. In Los Angeles severe pollution has often occurred with the inversion base (measured at the coast) at or below 1500 feet. The more serious cases of air pollution in the San Francisco area also have been experienced when the inversion base was near or below this height. It is believed that excessive air pollution in the San Diego metropolitan area will also be associated with inversion base heights at about 1500 feet or less.

Inversion base heights at N.A.S. North Island by months and for two different times of the day are shown in figures 41 and 42. Heights are broken down by 500 foot increments, and these are plotted as the percent of time the inversion base is at or less than these heights. Figures 41 and 42 indicate that there are strong seasonal and some daily variations in the inversion.

In figure 41, 0700 PST observations, it is seen that during winter when there is an inversion present, the base is usually at the surface. However, during winter and spring no inversions are present below 5000 feet 15-29 percent of the time. In summer the frequency of surface-based inversions generally drops off to less than 5 percent, but the frequency of inversions between 501 and 2500 feet increases considerably. It is seldom during summer and fall that there is not an inversion present below 5000 feet. Inversions at or less than 1500 feet may be expected a minimum of 18 percent of the time during April and a maximum of 69 percent during December.

Figure 42, 1900 PST observations, shows the same general seasonal variations as the 0700 PST observations. Nevertheless, there are some differences. During winter there is a greater percentage of no inversions at 1900 PST than at 0700 PST. Also there are almost twice as many surface-based inversions at 0700 PST as at 1900 PST in winter. Throughout most of the year there is a greater percentage of inversion bases between 501 and 1500 feet at 1900 PST than at 0700 PST. As a result, from April through October the inversion base is at or below 2000 feet more frequently at 1900 PST than at 0700 PST. This indicates that during summer the inversion base is lower at 1900 PST than at 0700 PST. However, this is not true during the remaining months when the frequency of surface inversions at 0700 PST is about double that at 1900 PST. The daily variation of the inversion will be discussed further in another section.

A seven-year summary (12) of the 0700 PST inversion base height at Long Beach is similar to our summary for North Island. Comparison shows that for each month, May through October, the inversion base is at or below 1500 feet about the same number of days at both sites. In the remaining months the inversion base is at or less than 1500 feet 4-6 days per month less at North Island than Long Beach. Both sites show that during winter most inversions are based at the surface, whereas during summer this is seldom the case.

The data for figures 41 and 42 are taken from tables 3-14, which give additional details on inversion characteristics by frequency of occurrence. Data in these tables have been presented in this basic form so that they can be used for summaries other than those presented in this report. The inversion base is defined as the lowest point above which temperature increases with elevation. The inversion top is defined as the point of maximum temperature that is associated with any temperature inversion, the base of which is below 5000 feet. By this method complex inversion conditions are tabulated as a single stable layer. The strength of the inversion increases as the temperature difference and thickness through the inversion increase. In figures 3-14 temperature difference and thickness are both tabulated with respect to height of the base. For instance, in table 3, January 0700 PST, the most frequent height of the base is the surface; of these 84 surface-based inversions the temperature difference is usually in the ranges 0-3 and 4-6° C (centigrade), and the thickness is most often 501-1000 feet. Tables 3-14 show that generally the temperature difference and thickness through the inversion are more frequently in the higher ranges during summer and fall than winter and spring. This is shown when we compare January, table 3, with July, table 9. Throughout the year the increase and decrease of frequencies in the higher temperature difference intervals follow the thickness variation.

In July, 1956 the vertical temperature (inversion) observation site was transferred from North Island, 24 feet elevation, to Montgomery Field, 407 feet elevation. The 1956 data included in table 9 are for Montgomery Field.

Because of the elevation of this site it was considered possible that many low inversions would not be revealed by the Montgomery Field observations. To test this a special tabulation was made of the frequency of occurrence that the inversion base, measured at North Island, was above the surface there and below the elevation of Montgomery Field. This criterion was used since it is very likely that surface inversions at North Island also would be at the surface at Montgomery Field. Of the 3381 North Island observations in tables 3-14 there were 77 cases when the inversion base was less than 407 feet and greater than 24 feet (that is, above the surface). This amounts to 2.3 percent. It appears then that inversion conditions presently being measured at Montgomery Field will miss only a very few low inversions.

Persistency and spatial extent of the West Coast inversion during summer may be determined from (1, figs. 2 and 3). These figures picture the inversion as most frequently extending from the central part of Lower California to the Oregon coast, and from the coastal mountains southwestward to the Hawaiian Islands. The inversion base is lowest and at approximately the same height, 1300 feet, all along the California coast. It slopes upward toward the Hawaiian Islands, reaching about 6600 feet there. Figure 43 (after (2)) shows the mean inversion base topography near the Southern California coast during two different summer periods. The figure shows the contour trough along the coast and the similarity of North Island observations with others near the coast.

During winter the inversion usually is not so persistent or extensive as during summer and changes somewhat in character. However, even at this time of year general inversion conditions are believed to be similar over the western part of the Southern California area, and at times along the entire California coast. Similarities in inversion base heights that have already been mentioned for North Island and Long Beach also have been observed in the data for Oakland. Large-scale meteorological features which affect general inversion conditions usually cover extensive areas and such widespread conditions are to be anticipated.

Temporal and spatial inversion variations are interrelated and are discussed here together. Most studies of the coastal inversion have been made as a part of stratus cloud investigations, and therefore are confined to the summer season when these clouds are most frequent.

Inversion conditions are seldom stationary. Variations occur from day-to-day and throughout most days (see 2). In 1934 (13) it was pointed out that summertime inversion observations from North Island indicated that the 0800 PST inversion base averaged 337 feet higher than the 1300 PST observations made on the same days. From figures 41 and 42 and tables 3-14 it is seen that in summer the North Island inversion base is more frequently lower at 1900 PST than at 0700 PST. Summertime inversion data for Long Beach (1, p. 10) show that the base averaged 409 feet higher at 0700 PST than at 1900 PST. These data indicate that the diurnal variations of inversion base heights are similar at the coasts of both the San Diego and Los Angeles areas. A detailed study (2) of the diurnal variation of the inversion base, made for the Los Angeles area, showed that during summer the inversion base at the coast often is lowest from about 1100 PST to 1500 PST and is highest at about 0700 PST. The range between highest and lowest points is 500 feet. This variation has been explained (2) as follows:

> As the sea-breeze begins soon after sunrise it penetrates inland and merges with slope- and valley-mountain winds that move the air eastward. This flow removes air from the coastal area. Further at sea the normal northwesterly winds do not replace the coastal air as quickly as it is evacuated and the inversion settles. This effect continues as forenoon sea-breeze speeds increase and remain high throughout the afternoon. During summer evenings, speeds over the land become very light and as the air arriving from further at sea accumulates near the coast the inversion base is lifted. Thus, at the coast the inversion base is highest about 0700 PST; it descends during forenoon and is lowest during about 1100-1500 PST; throughout the evening and early morning it ascends to its maximum height at 0700 PST.

It should be kept in mind that this general description applies to the summer season at sites immediately along the coast. Further inland daytime heating of the ground also is important in determining the diurnal variation of inversion base height. As solar radiation warms the ground, the temperature of the air in contact with the earth's surface is increased. This heating from below causes the air to be less stable, and is more conducive to mixing beneath the inversion base. As heating and mixing continue, the cold stratum of air under the inversion is warmed, and the inversion is partially overcome. If heating is sufficient, the inversion may be completely "wiped out". On summer days the surface air temperature is commonly observed to increase with increasing distance inland from the shore. Daytime sea surface temperatures are raised very slightly. Thus, in the absence of other factors, the effect of daytime heating over land is to raise the inversion base height, sometimes even wiping it out.

Other factors also influence the height of the inversion. It has been concluded (2) that the merging of the sea-breeze and mountain-breeze may produce the same effect over land as at the coast. That is, air blows out from beneath the inversion faster than it is replaced and the inversion settles. In addition, as the sea-breeze becomes stronger it increases in depth (2, pp. 55-65). If it reaches the height of the lower inversion along the coast, it then carries this inversion inland. While these two factors do not completely offset the inland heating effect, they do work against it. Both factors are less effective at greater distances inland. Figure 44 (after 2) gives typical summertime average inversion base profiles from the ocean inland to Pasadena. In this figure the curves were drawn for an average of the two near-coastal sites, UCLA and Santa Ana. Solid contours of figure 43 are based on the same observations as figure 44. It should be kept in mind that while the sea-breeze tends to lower the inversion base, higher wind speeds favor dispersion.

During the colder part of the year inversion conditions are quite different from summer. Figure 41 shows that in winter at 0700 PST the inversion base is most frequently at the surface. At 1900 PST, figure 42, the inversion base is not so frequently at the surface, and the frequency of all inversions is also less at this time. This is opposite to summertime conditions when the inversion base at the shore tends to be higher in the early morning and lower during afternoon and evening.

During winter, although daytime temperature differences between shore and inland sites usually are not so great as during summer, there is an appreciable diurnal range of temperature. With inversions at the surface, heating from below raises the inversion base. Also, the afternoon sea-breeze with higher speeds than at night results in some surface turbulence which is not conducive to surface inversions. In addition, the afternoon influx of moist marine air would delay the formation of surface inversions. The foregoing are some of the reasons surface inversions are less frequent during winter at 1900 PST than at 0700 PST. Lowering of the inversion base by the sea-breeze evacuating air from beneath it is not believed to be so frequent or so great as in summer.

Effects on the inversion base height due to surface heating have already been mentioned. Such heating is even more effective in weakening inversions when the heated surface is elevated. In order to gain some idea of the effect on the inversion base due to surface heating, one year of data has been summarized in table 15.

The top portion of this table summarizes observed inversion conditions at North Island. Average inversion base heights are higher at 0700 PST than 1900 PST from April through October. Also, there are more inversions observed at both 0700 and 1900 PST on the same day during summer and fall than other seasons. The reason inversions were not included in the table at both times on each day is because either none was observed below 5000 feet or observations were missing. There were usually a few missing observations in each month.

During winter many of the daily 0700 and 1900 PST inversion base heights were observed at the surface, but there were more 0700 PST heights at the surface than at 1900 PST. Thus, in table 15, during the cooler part of the year average 1900 PST heights are above those at 0700 PST.

The remaining portions of table 15 summarize computations of the inversion base height due to surface heating at several places. The daily maximum surface air temperature has been used. Since this temperature generally occurs between 1200 and 1500 PST the computations apply to inversion conditions at that time. The computations were made by plotting the observed 1900 PST inversion on a temperature vs. altitude chart. At each site the maximum temperature for that day was plotted at the altitude of the observation site. An air parcel from this point was then lifted and cooled (due to reduced pressure) until it intersected the observed plotted inversion or reached an elevation above the inversion top. In the former case the elevation of the intersection point would be the new inversion base height, except where the intersection point was above 5000 feet in which case the inversion would be listed as wiped out. In the latter case the inversion would also be tabulated as wiped out. In these computations the assumption is made that except for the effect of warming from below, observed 1900 PST inversion conditions reasonably approximate conditions at the time of maximum temperature. It is believed that although this assumption is not always valid it usually would be true.

The computations were made from maximum temperatures at Lindbergh Field, Bonita, El Cajon and Ramona. Respectively, these sites are 4.5, 6, 16 and 25 miles inland from the sea coast. So located, they give an idea of the inversion variation inland during the afternoon.

Table 15 shows that for sites at greater distances inland and over higher terrain, average inversion base heights increase throughout the year. It should be pointed out that because most inversions are wiped out in winter at El Cajon and Ramona, average inversion heights at these stations are based on very few data. The number of days that the inversion is wiped out by surface heating also increases with increasing distance inland. At Lindbergh Field and Bonita the inversion is less frequently wiped out by surface heating during summer. This is partly because the inversion is stronger in summer and because maximum temperatures are lower near the coast than inland. During July, 1950, for example, average maximum temperatures at Lindbergh Field, Bonita, El Cajon and Ramona were 76°, 77°, 86° and 93° F., respectively, while during January, 1950, they were 64°, 66°, 68° and 65° F., respectively.

At Lindbergh Field average computed inversion base heights during June are between observed 0700 and 1900 PST averages. During the other months, April through

September, average computed inversion base heights were usually only a very few hundred feet higher than observed average 0700 PST heights. Even so, there were a considerable number of days during April-September when the computed inversion base was at or between observed 0700 and 1900 PST heights at Bonita as well as Lindbergh Field. Further inland at El Cajon and Ramona, where surface heating is greater, the inversion was more effectively weakened.

Necessary assumptions in inversion base computations may have resulted in heights being slightly too high. However, the data of table 15 are believed to give a reasonable idea of inversion base variations due to heating effects over elevated terrain.

Nocturnal cold air drainage may produce local inversions where the topography favors the accumulation of such cold air - as in valleys and canyons where the inflow of cold air exceeds the outflow. Figure 45 (after 5) shows the manner in which nocturnally cooled air descends into a valley and an observed temperature distribution resulting from such a condition. It is likely that cold air drainage is widespread over San Diego County when surface-based inversions occur at North Island.

A summary of general inversion conditions indicates that during summer at the coast the inversion base is frequently below 1501 and 2001 feet. It is highest about 2 hours after sunrise and lowest during the afternoon and evening. Further inland surface heating tends to raise the inversion base and weaken it.

In winter, inversions are less frequent but those that do occur are often based at the surface. This is especially true at night and early morning. During the day the inversion base lifts and by early evening often is still above the surface. Surface heating weakens the inversion in winter also.

Cloudiness and Solar Radiation: Photochemical reactions likely are necessary to the formation of atmospheric materials associated with eye irritation and plant damage (15, pp. 40-62). The incidence of solar energy near the ground then is important in such reactions. Moderately thick clouds act as rather good insolation reflectors (16), and therefore may limit the availability of solar energy in the atmosphere below.

It should be clear that the effect of cloudiness is to reduce the amount of incoming solar energy (17, 18). In the absence of clouds, solar energy along the Southern California coastal area varies by a factor of about two from winter to summer (19). Solar radiation data for La Jolla are given in (17, 18 and 19).

Figure 46 shows mean sunshine and cloudiness conditions at Lindbergh Field. Sunshine is recorded when the solar disk is visible. In the top diagram the monthly mean percent of possible sunshine varies between 58 percent in June and 76 percent in November. Possible sunshine is less tnan 60 percent during April, May and June, and exceeds 70 percent in February, March and November.

The bottom diagrams of figure 46 show the diurnal variations of cloudiness in summer and winter, July and December. Throughout winter days comparatively small changes in cloudiness occur. Cloudiness differences between summer days and nights are appreciable. Although cloudy conditions (8-10 tenths sky covered) are very frequent during summer mornings, clear conditions (0-3 tenths sky covered) during summer afternoons are more frequent than in winter. This factor, with that of more incoming solar energy in summer, increases the availability of energy for photochemical reactions for this season. While the diurnal cloudiness variation decreases throughout the fall season, clear conditions exceed 70 percent in afternoons through October (6).

The large percentage of cloudy conditions on summer nights is not favorable to the formation of surface-based inversions, whereas the large percentage of clear conditions on winter nights is favorable to the formation of surface inversions; see figure 41.

CONCLUSIONS:

1. General meteorological conditions over the western portion of San Diego County are quite similar to those in the Los Angeles area. Much can be learned about the winds and the inversion conditions in San Diego County by a review of reports that have

been made on the relationship between meteorology and air pollution in Los Angeles.

2. The summaries presented indicate that throughout the year the time of better atmospheric dispersion is early afternoon, and summer afternoons are more favorable than afternoons of other seasons. These are the times when the sea-breeze is strongly developed. During the day the sea-breeze circulation often causes the height of the inversion base along the coast to decrease slightly. This effect, which tends to reduce atmospheric dispersion, is compensated by higher wind speeds.

3. Surface heating raises and weakens the inversion. Such surface heating will be most effective in weakening and, in many instances, wiping out the inversion over higher inland terrain.

4. Although vertical temperature (inversion) observations are currently being made at Montgomery Field from 407 feet elevation rather than near sea level, this is not considered to be a serious limitation to obtaining accurate inversion data. As indicated in the text, only about 2.3 percent of the inversions are not expected to be observed from Montgomery Field.

5. This limited study could not be expected to adequately answer questions on location of new major sources of emissions so as to reduce to a minimum their contribution to the air pollution problem. From the wind and inversion summaries and knowledge of meteorology certain observations can be made:

   a. Winds should be expected to blow from any and all directions at all sites during some portion of the time. Therefore, it is not possible to locate an air pollution source so that it will never affect populated areas. This will be particularly true as the county continues to grow.

b. Available information indicates that from air pollution considerations only, the more desirable locations for new major sources of emissions are at inland sites near the 1500-foot level or higher, and there on terrain that rises above the surrounding area. Inversions would often be absent or weaker at such places and the frequent westerly winds would usually carry pollutants eastward, away from present population centers. Specific location problems of emission sources should be considered in more detail.

c. Location of heavy traffic, major air pollutant sources and large dense population centers should particularly be avoided in valley and box canyons, if possible. In such places air flow is often markedly restricted.

d. The high frequency of light nighttime winds over San Diego Bay is favorable to the accumulation of pollutants there. These pollutants are carried inland by the daytime sea-breeze. When the sea-breeze fails to develop or remains weak, and if the inversion is low, severe air pollution episodes may be expected.

RECOMMENDATIONS:

1. That San Diego County make continuing studies of the meteorological conditions leading to and associated with air pollution episodes. Such studies will contribute to a better understanding of the county's air pollution problem.
2. That San Diego County collect wind data from organizations that are presently making such observations, and that other

organizations which may be able to contribute such data be urged to do so. Such a wind reporting network could be augmented by a few county-operated wind instruments. All these wind data could be used to determine more detailed air flow patterns and trajectories. Such information would be useful in item 1, above, and would enhance the county's progressing air sampling activities.

3. That in their developing air pollution program, San Diego County utilize meteorological consultation and advice for the design and operation of the supporting meteorological services.

ACKNOWLEDGMENTS:

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The report has also been reviewed by the U.S. Weather Bureau, Office of Meteorological Research, Washington, D.C.; the Meteorology Section of the U.S. Public Health Service's Community Air Pollution Program, Cincinnati, Ohio; offices of the U.S. Weather Bureau in San Francisco; and by faculty members of the U.C.L.A. Department of Meteorology.

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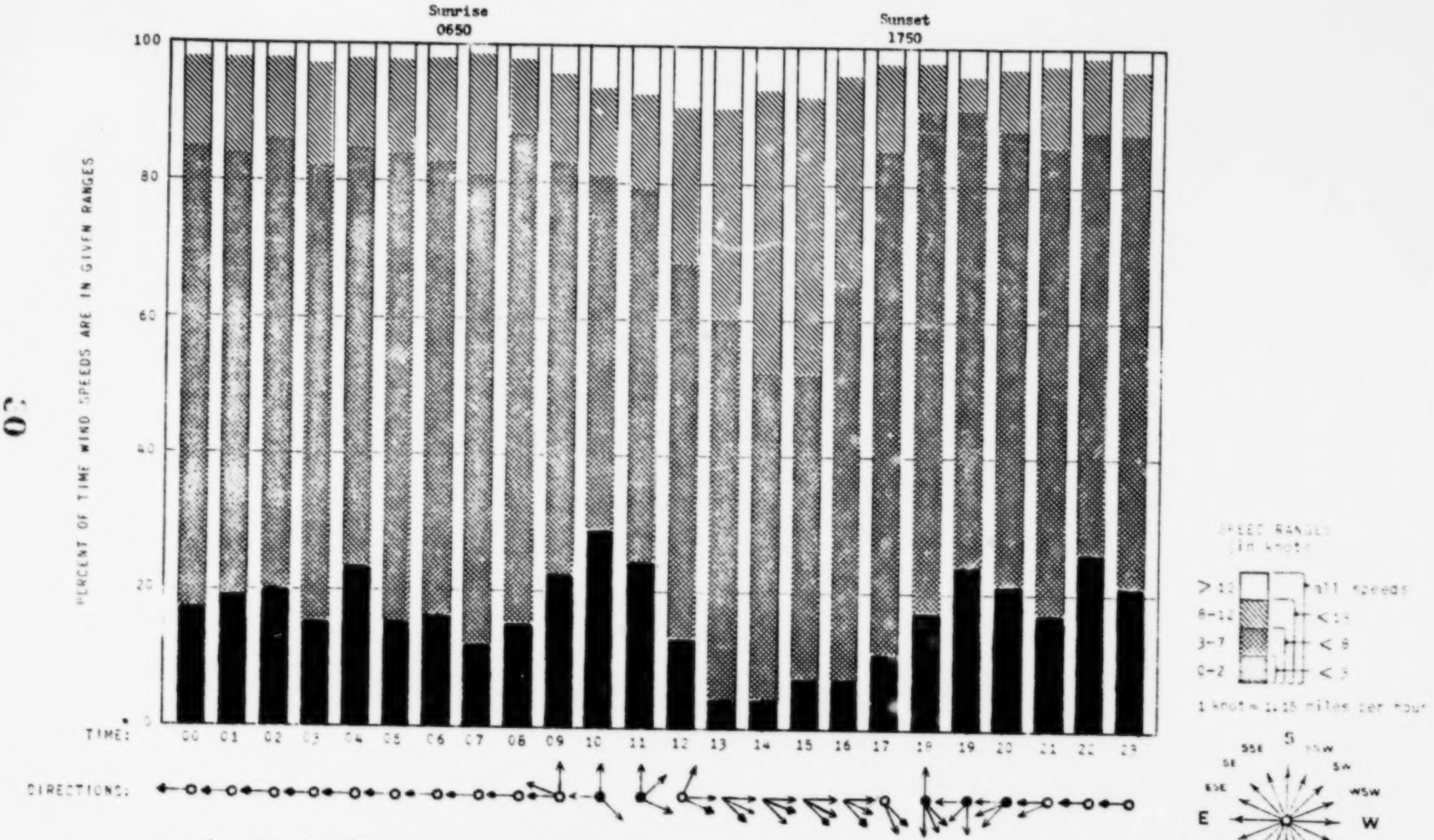
FIGURE I

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

JANUARY 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

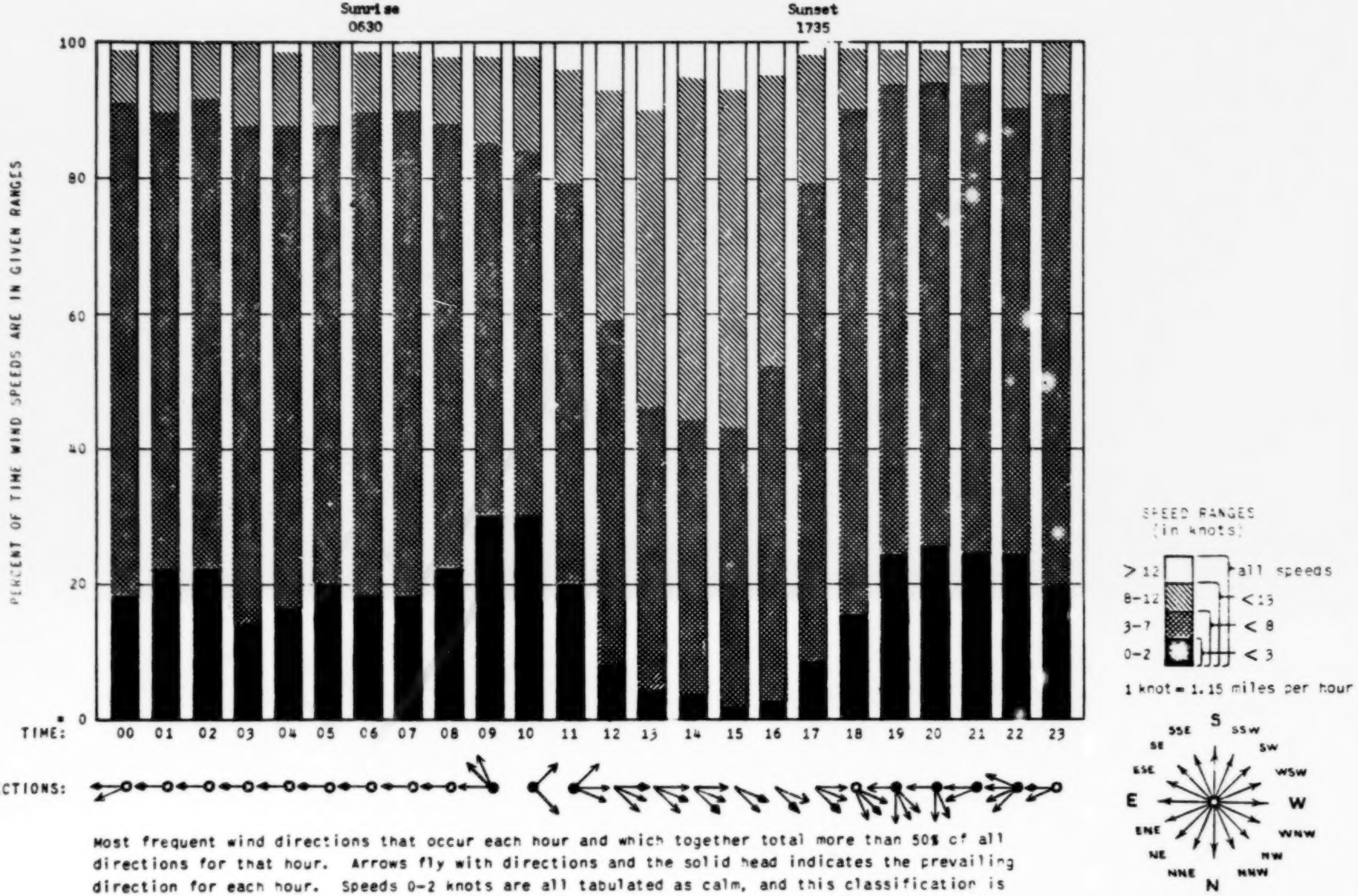
[illegible]CH

FIGURE 2

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

FEBRUARY 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as O and prevailing calm as ●.

G.C.H

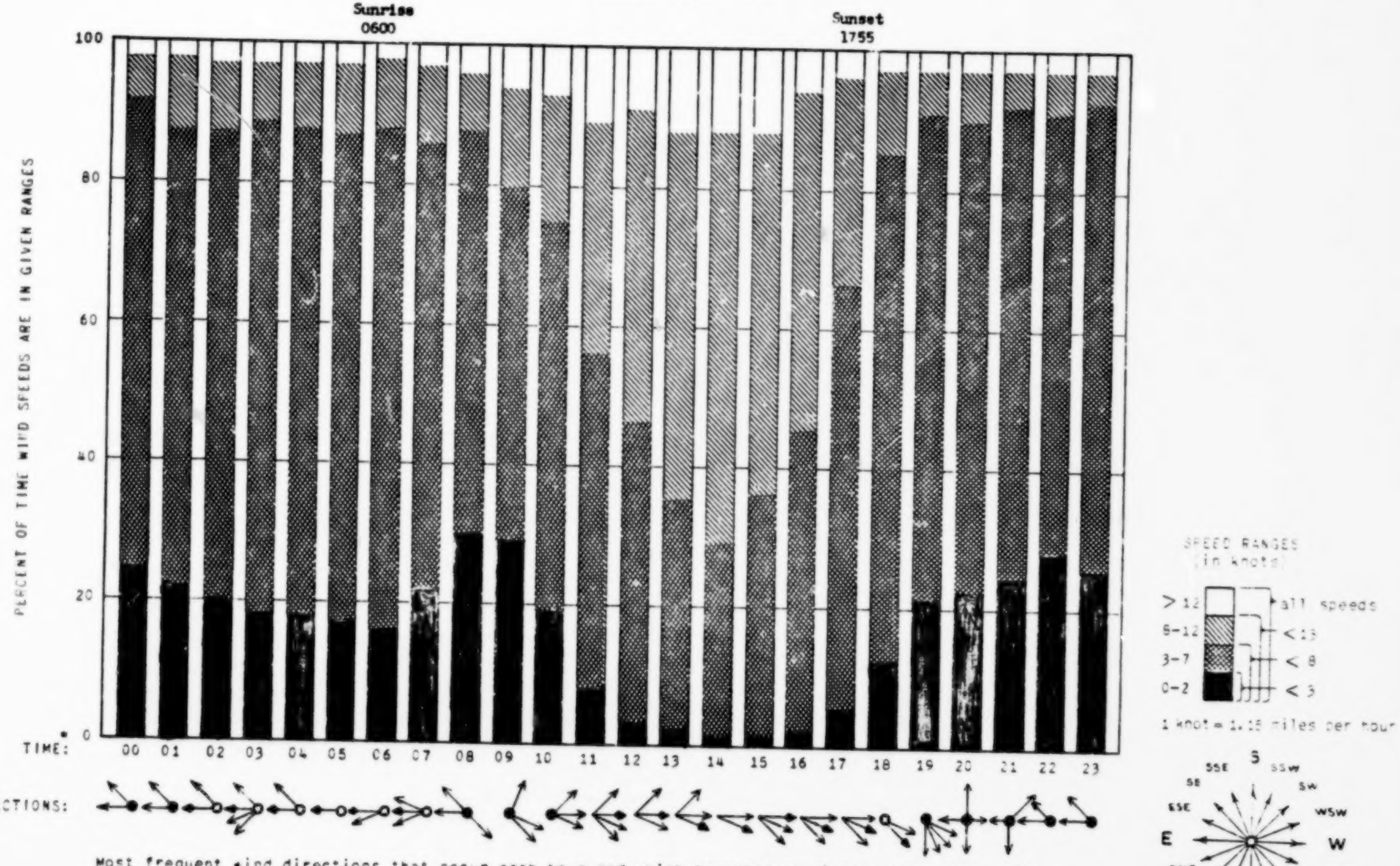
* Observations made during hour shown.

FIGURE 3

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

MARCH 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as O and prevailing calm as ●.

* Observations made during hour shown.

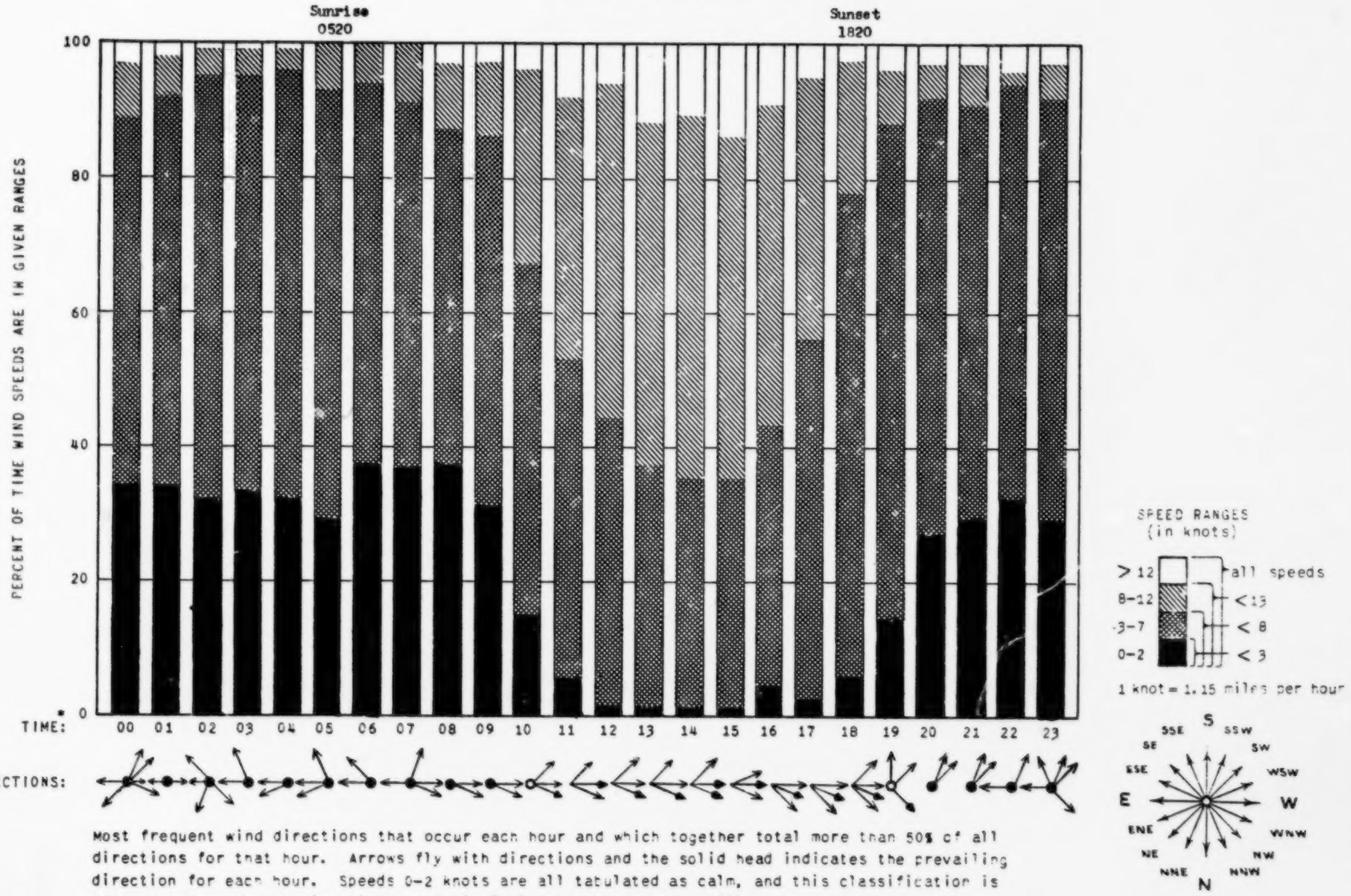
R.CH

FIGURE 4

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

APRIL 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0–2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

G.C.H.

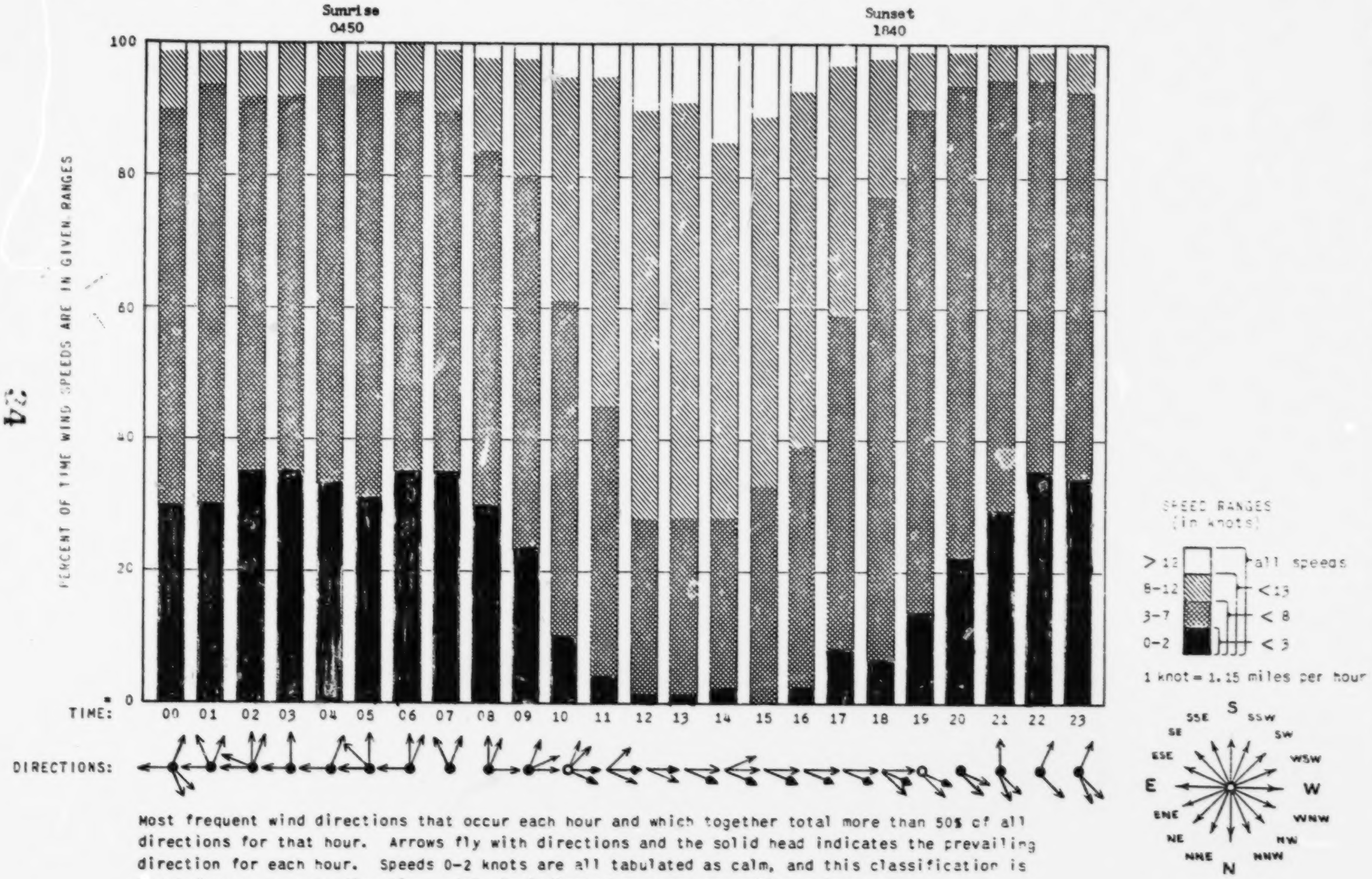
* Observations made during hour shown.

FIGURE 5

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

MAY 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

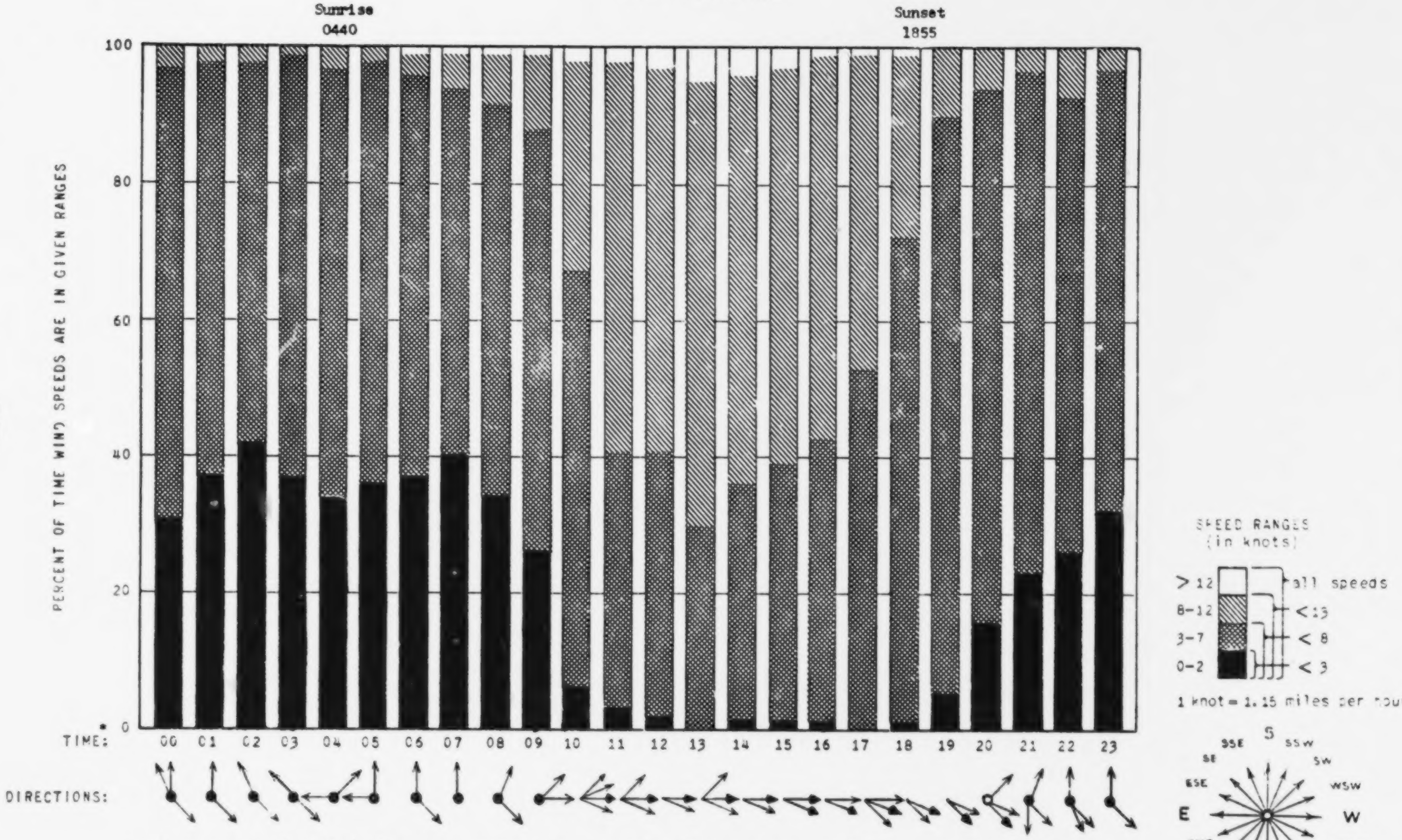
G.C.H.

FIGURE 6

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

JUNE 1948-1953



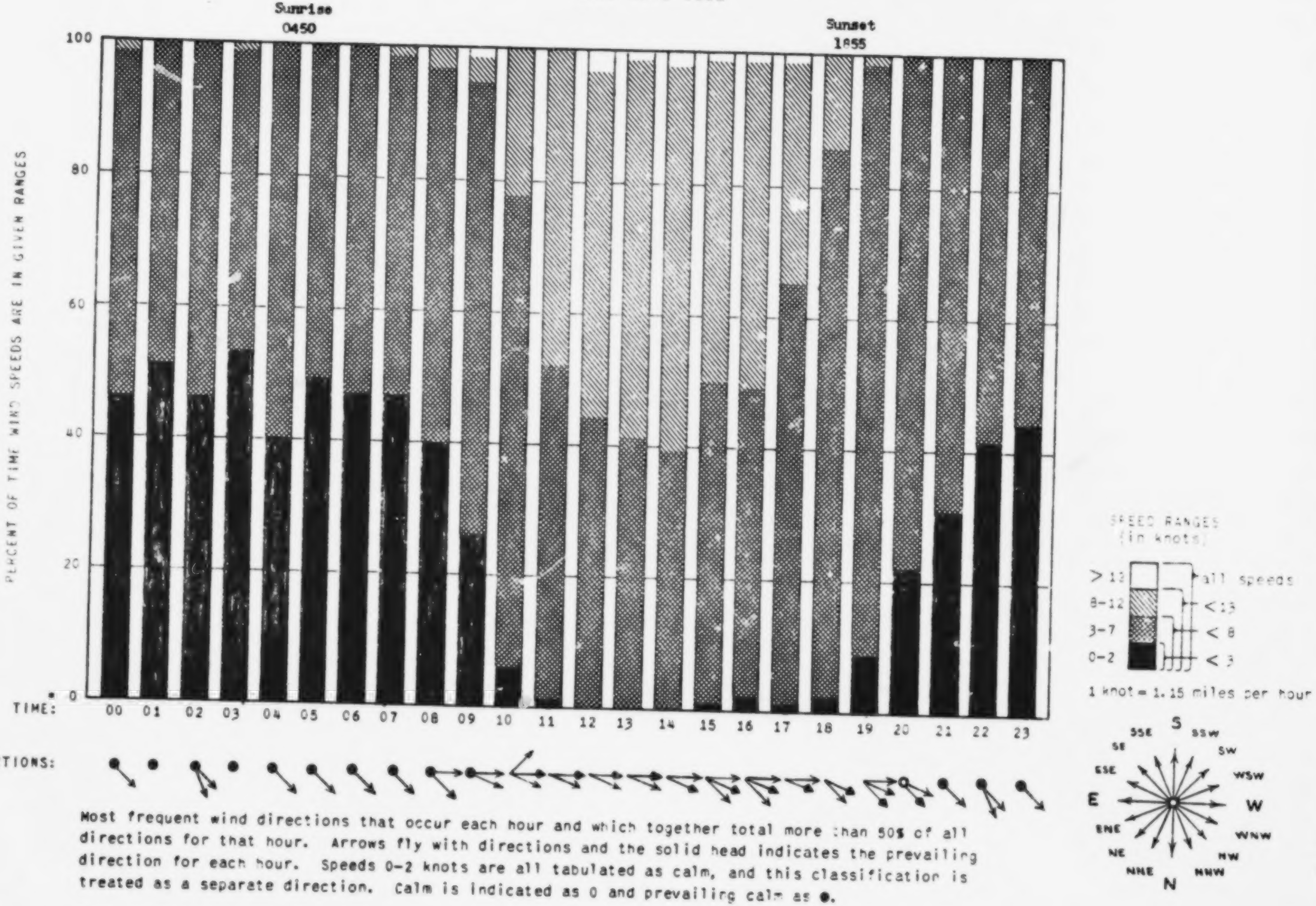
Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

G.H.

FIGURE 7

HOURLY WIND SUMMARY
N.A.S. MIRAMAR
JULY 1948-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

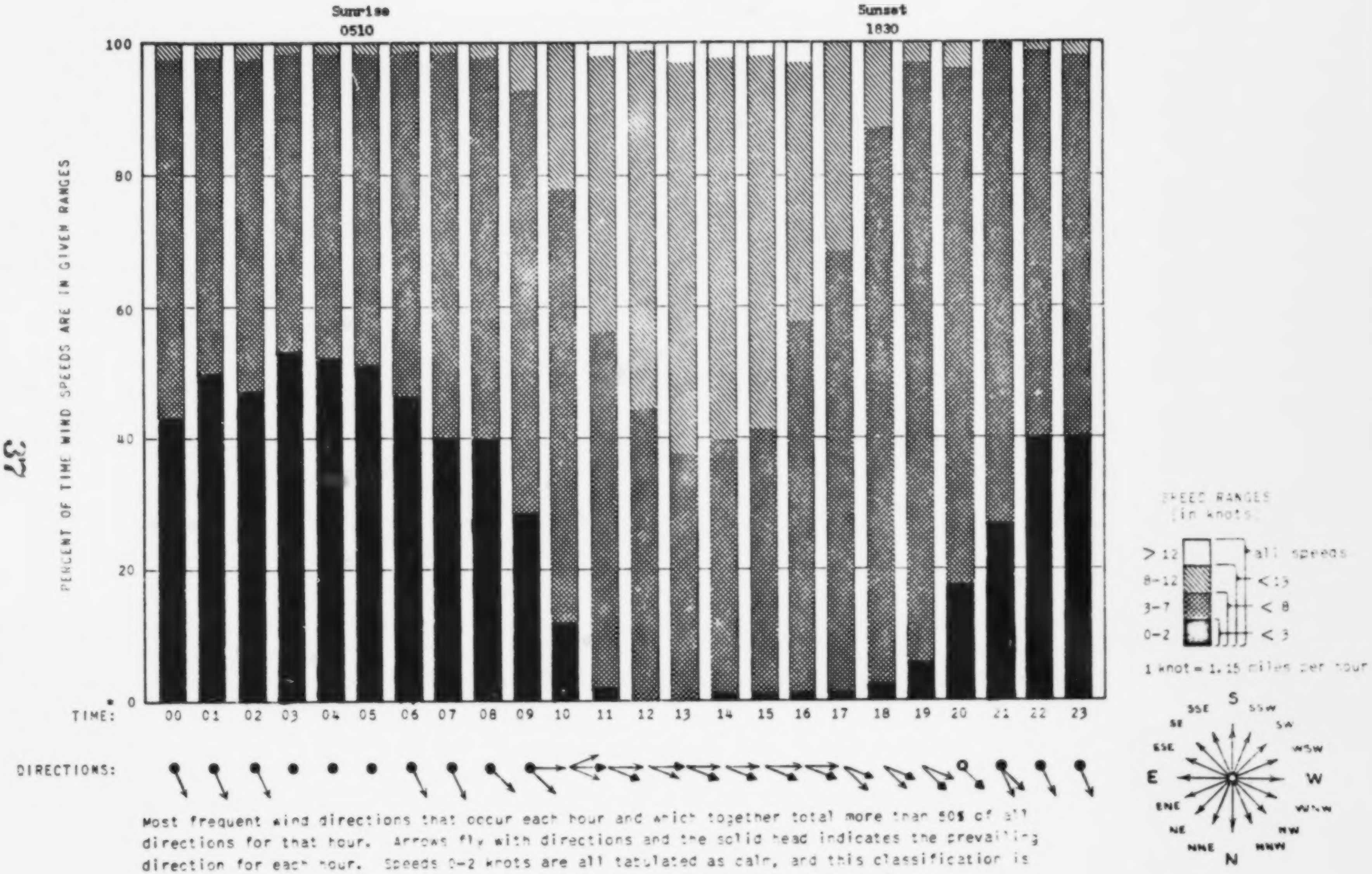
S.C.M.

FIGURE 8

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

AUGUST 1947-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

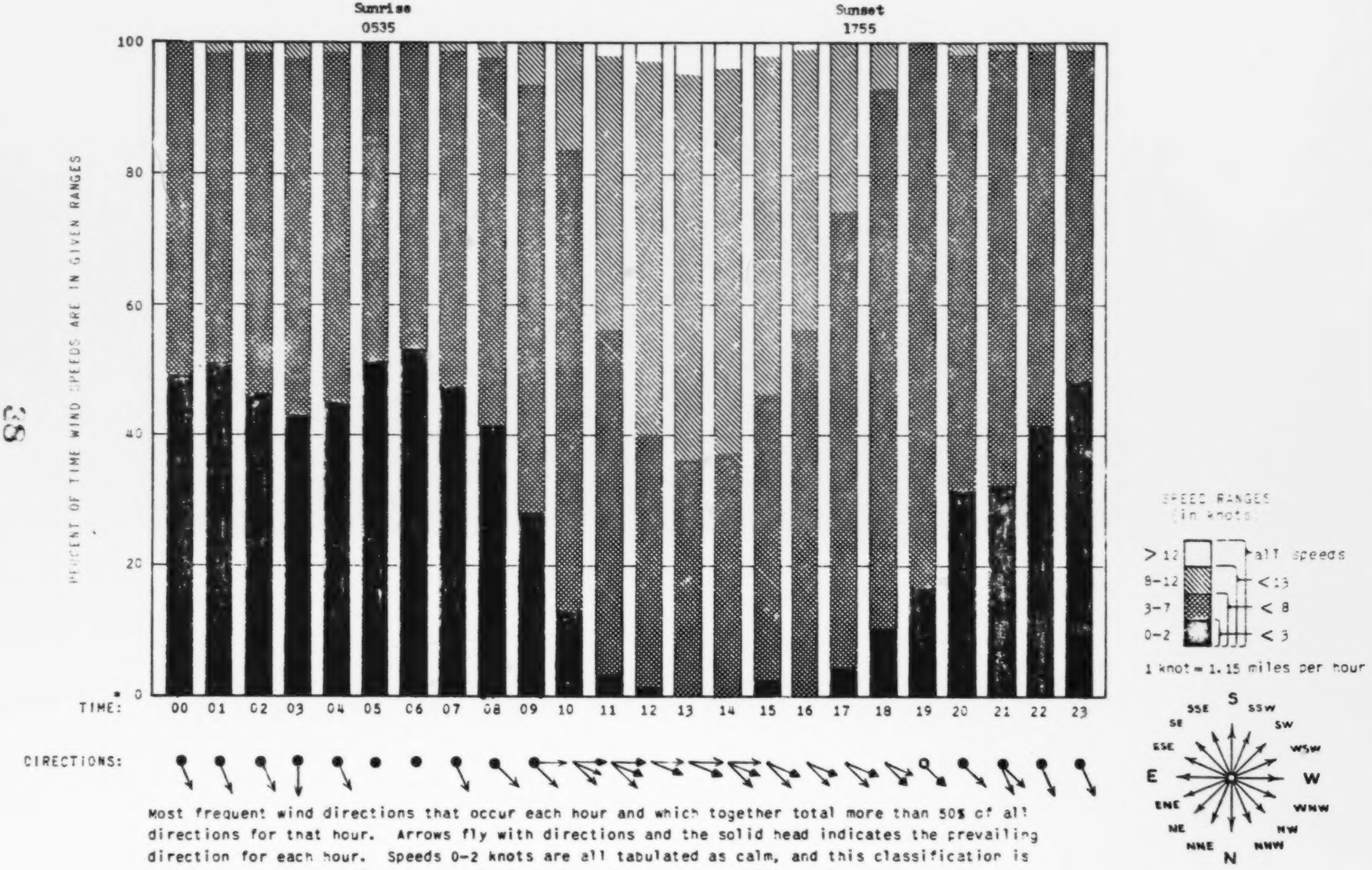
* Observations made during hour shown.

FIGURE 9

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

SEPTEMBER 1947-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

G.C.H.

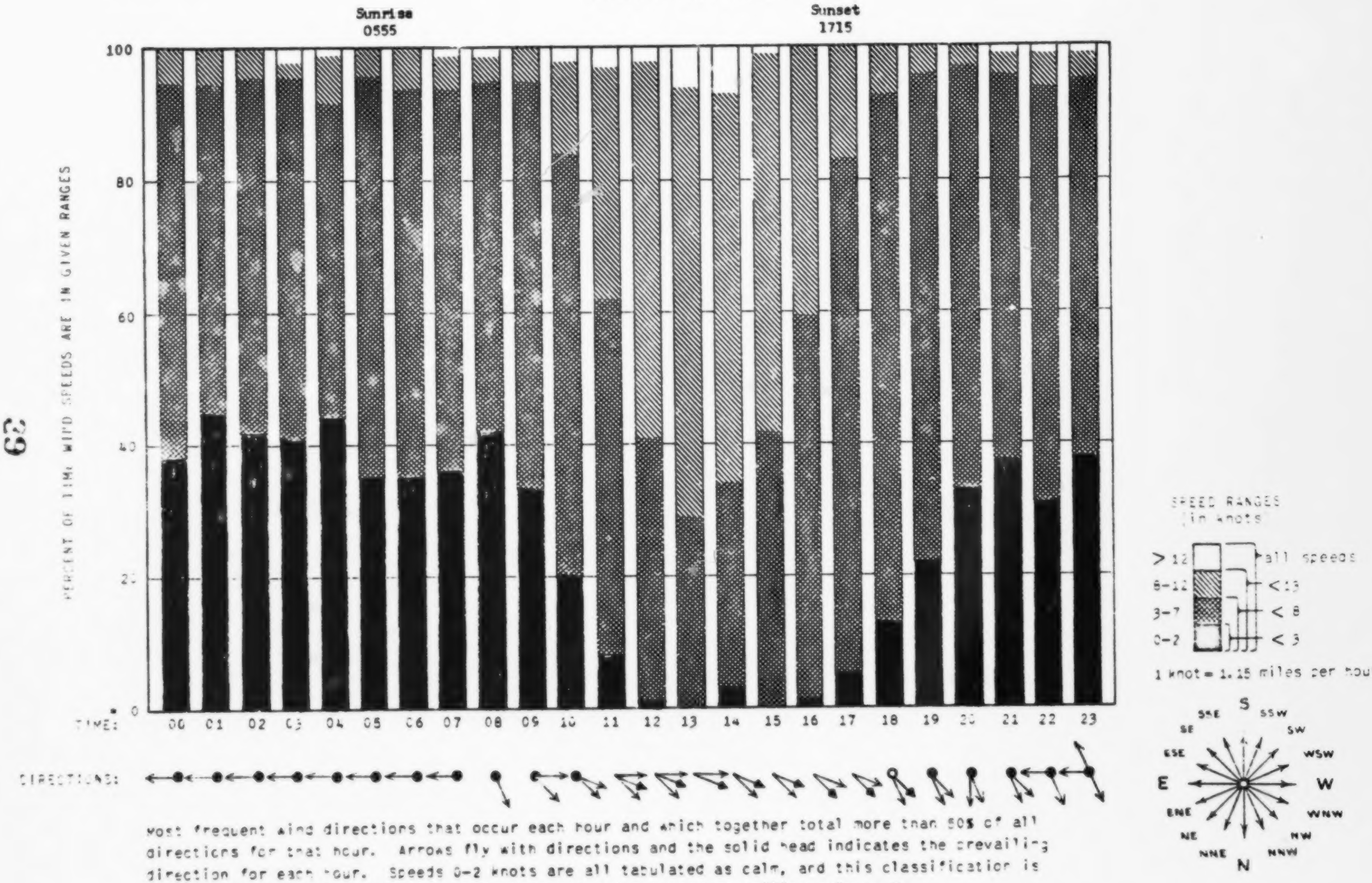
* Observations made during hour shown.

FIGURE 10

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

OCTOBER 1947-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as O and prevailing calm as ●.

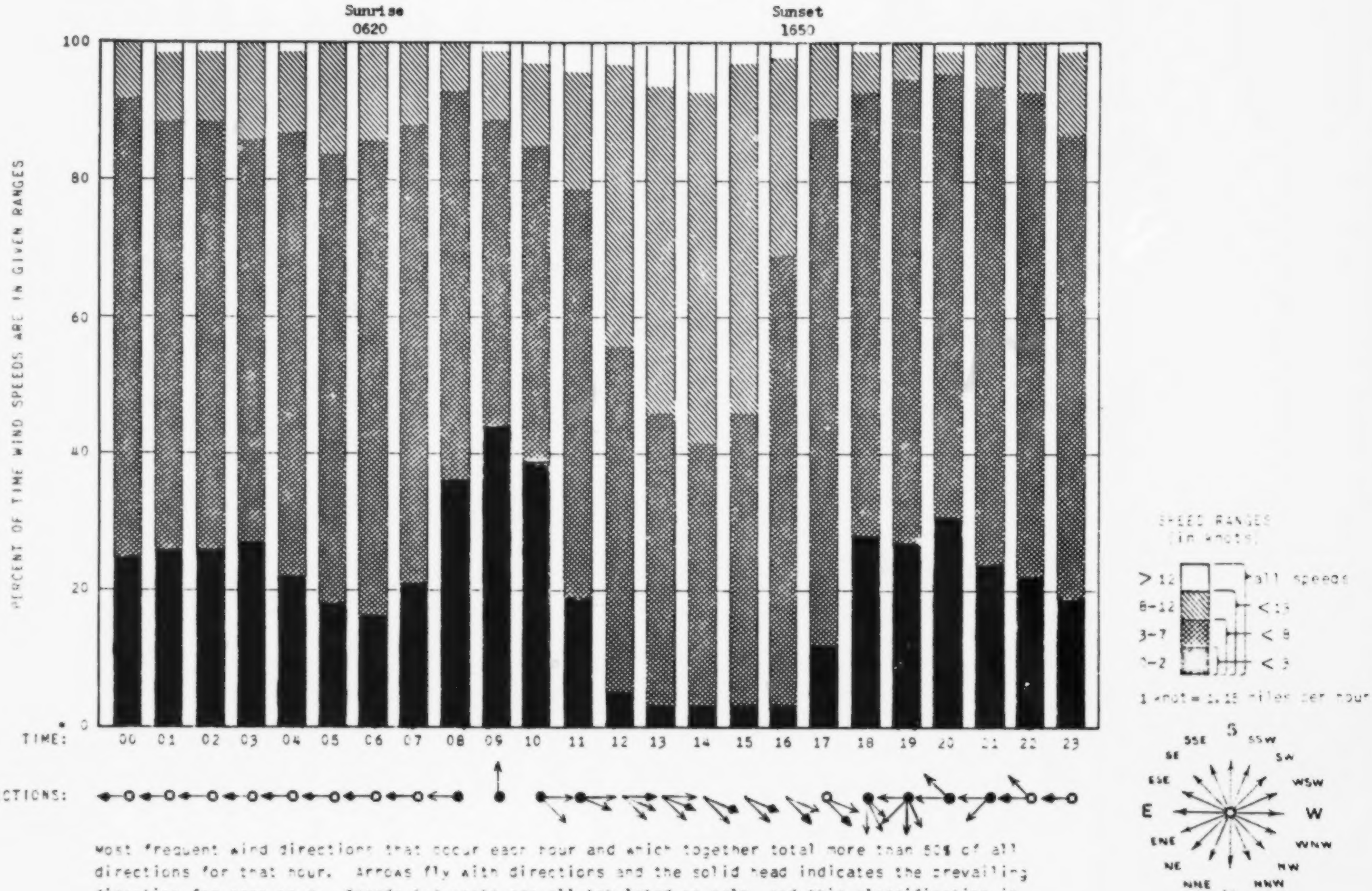
* Observations made during hour shown.

FIGURE 11

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

NOVEMBER 1947-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as O and prevailing calm as ●.

.C.H.

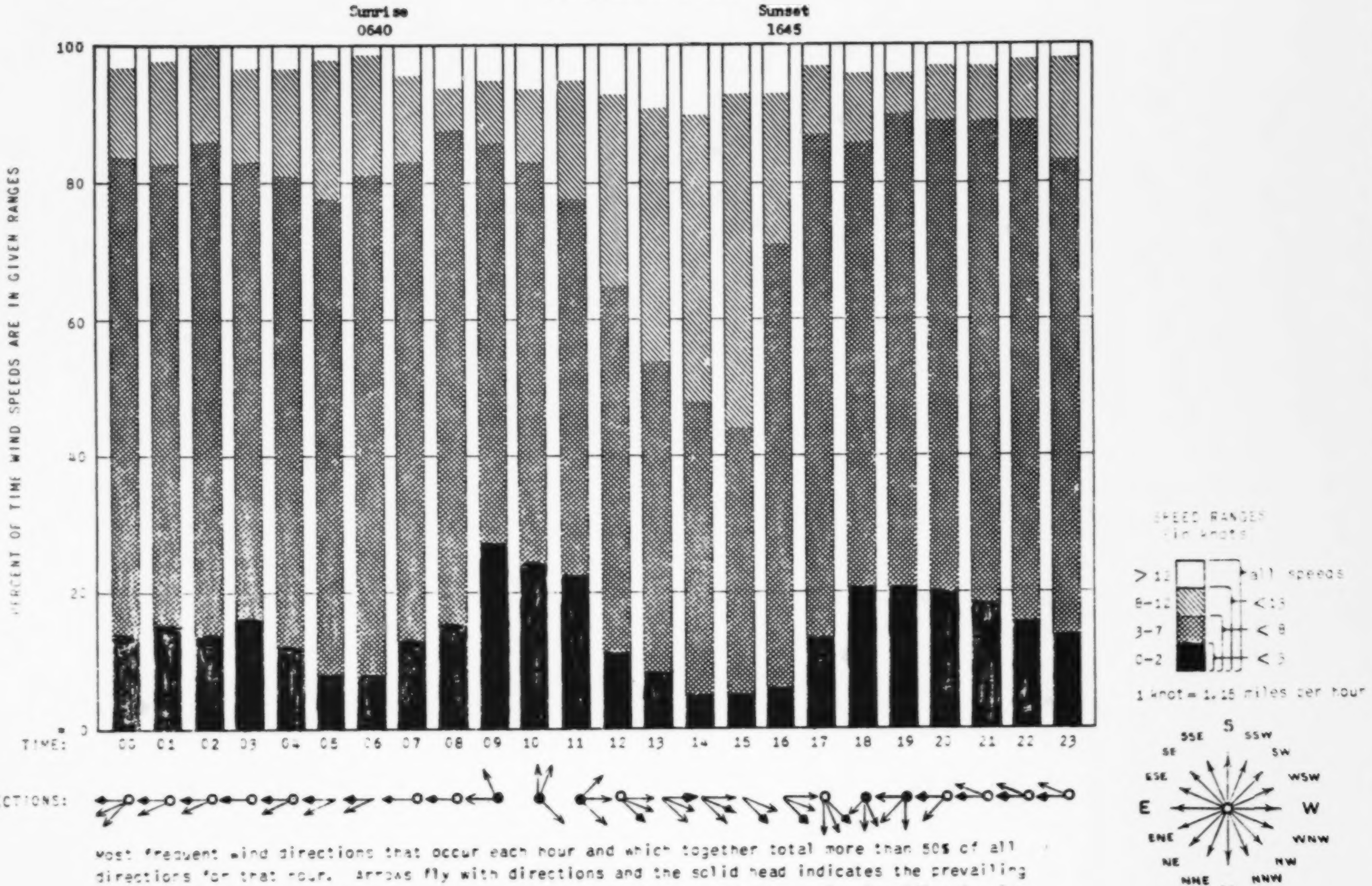
* Observations made during hour shown.

FIGURE 12

HOURLY WIND SUMMARY

N.A.S. MIRAMAR

DECEMBER 1947-1953

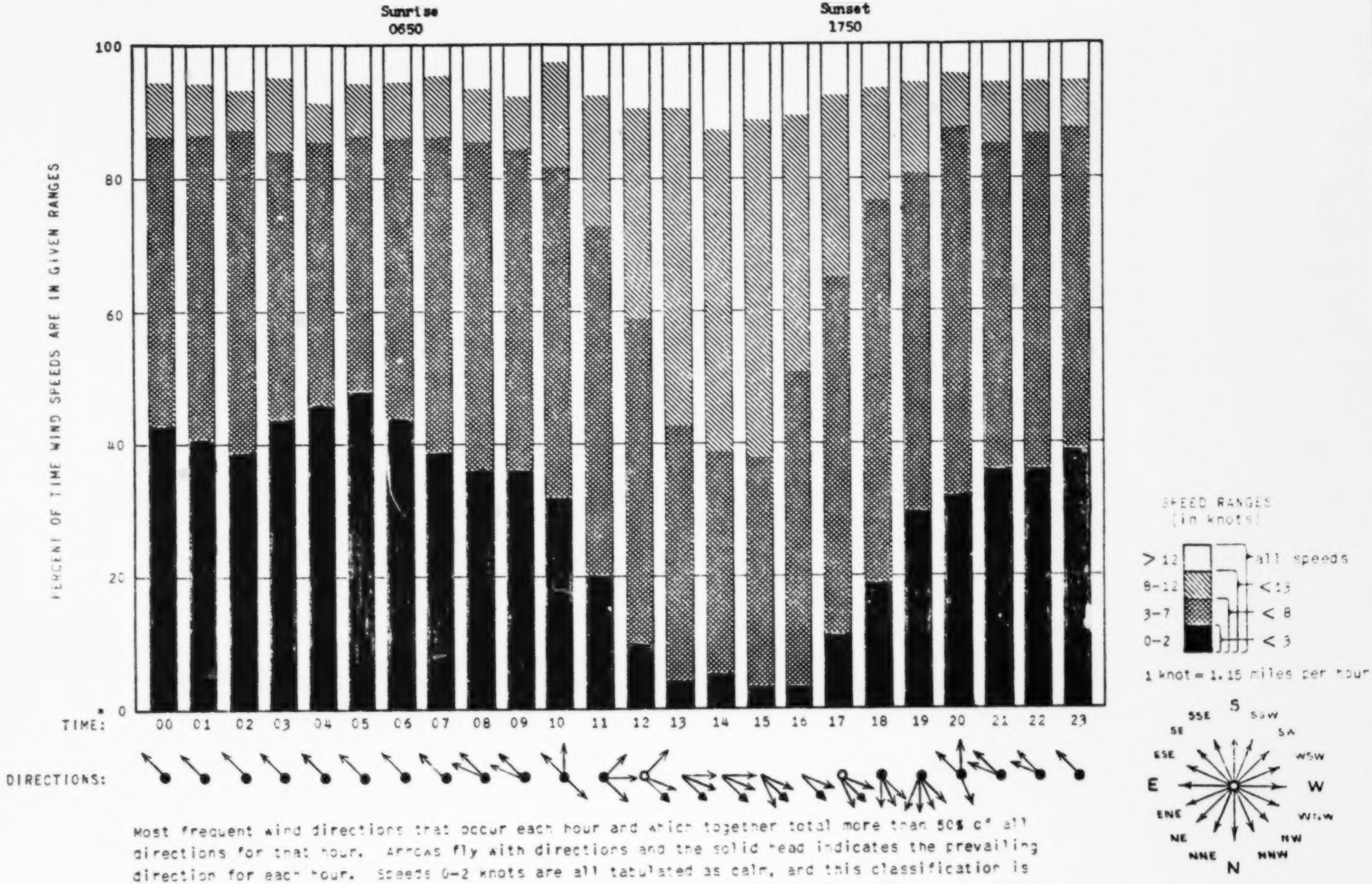


Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

HOURLY WIND SUMMARY
N.A.S. NORTH ISLAND
JANUARY 1946-1952

FIGURE 13



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

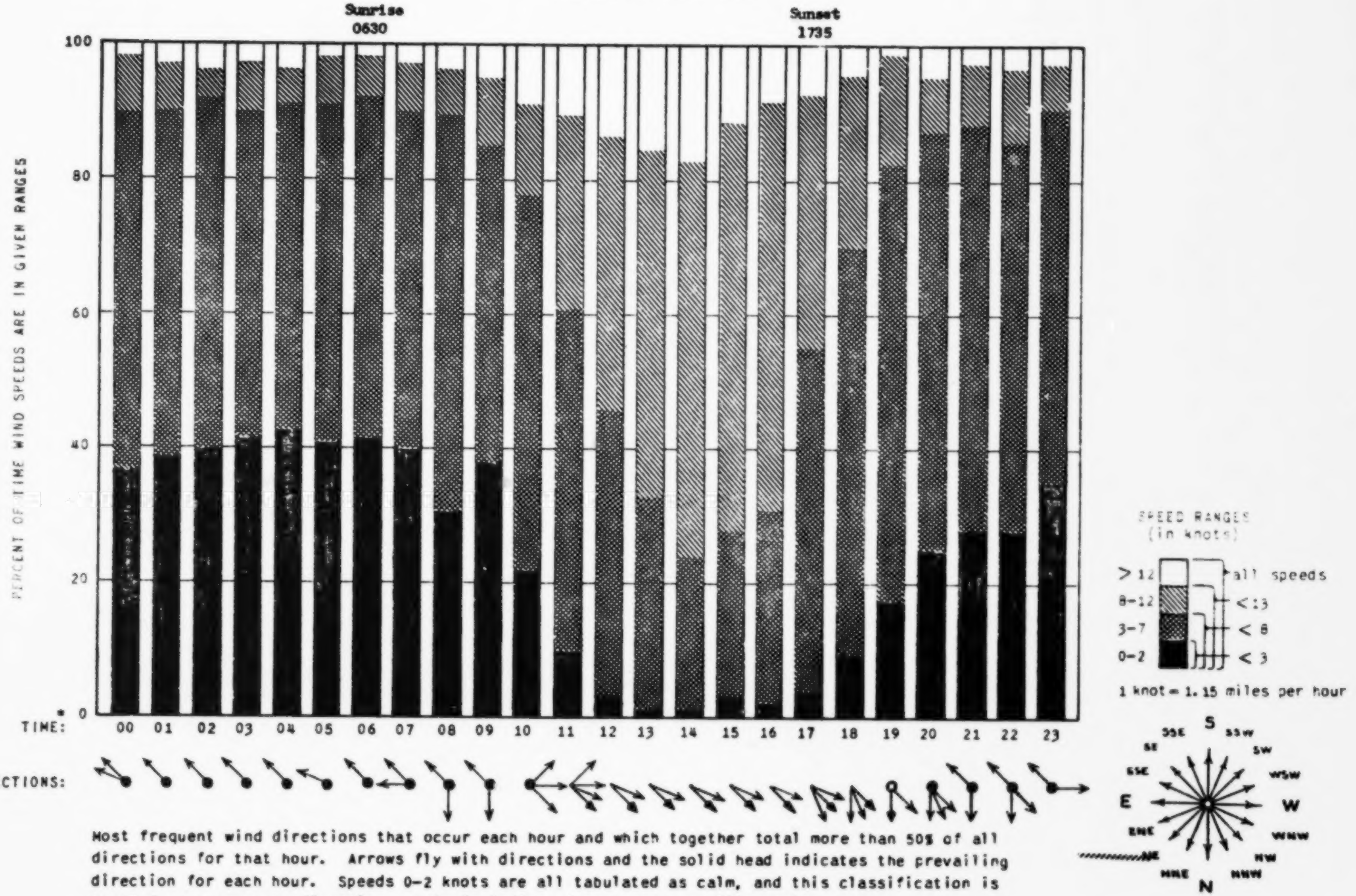
G.C.H.

FIGURE 14

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

FEBRUARY 1946-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

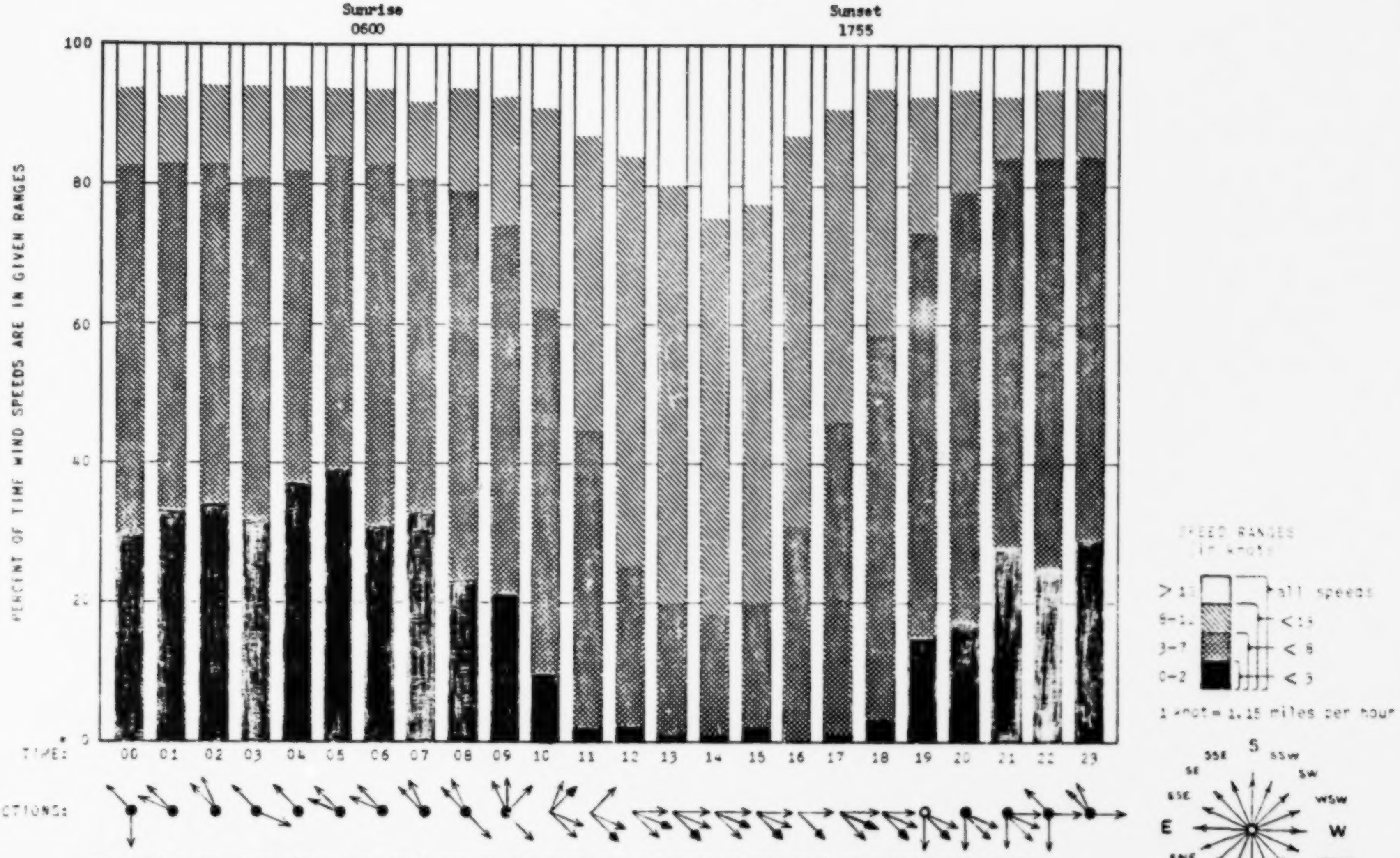
G.C.H

FIGURE 15

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

MARCH 1946-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

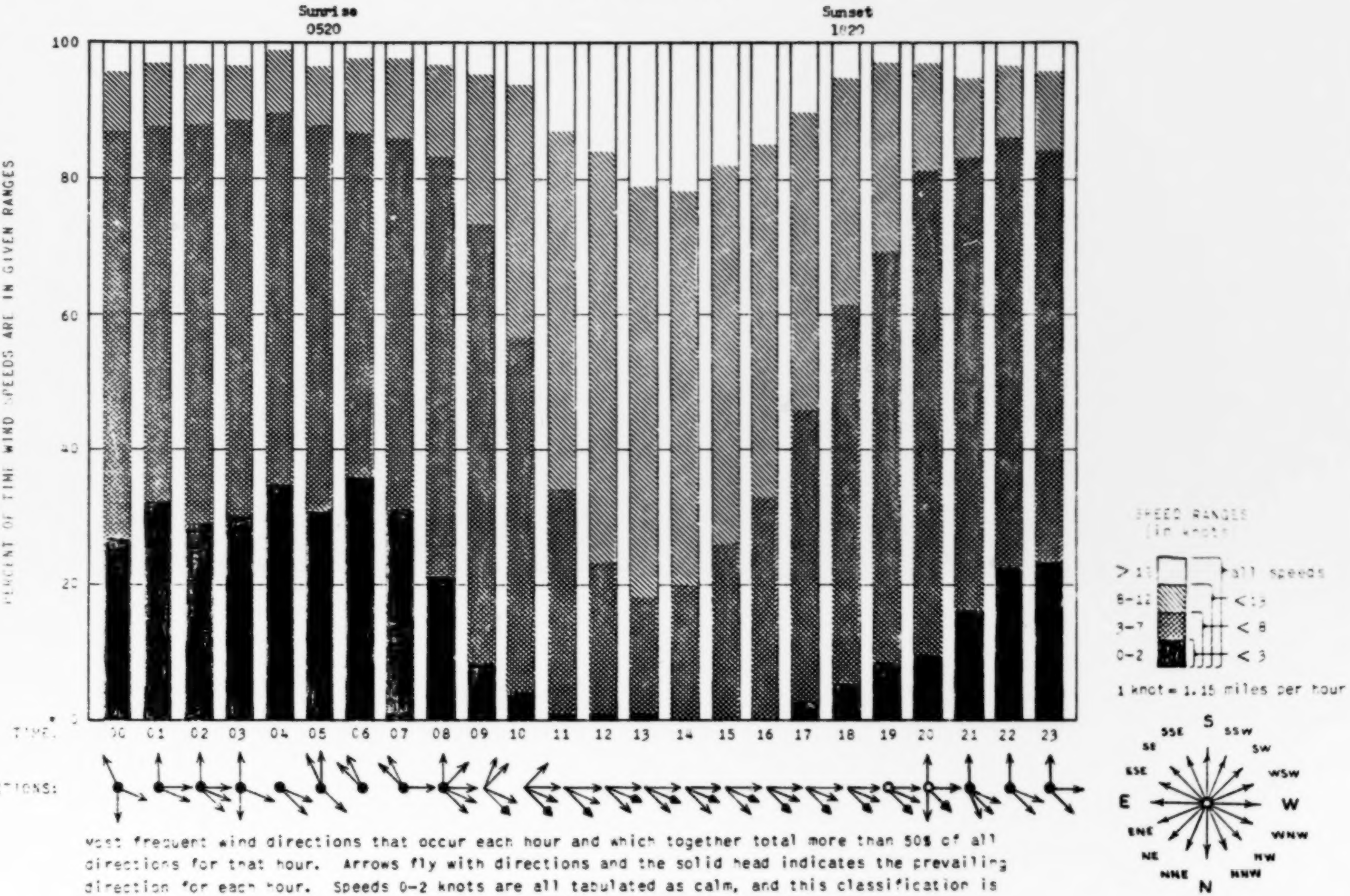
G.T.H.

FIGURE 16

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

APRIL 1945-1952



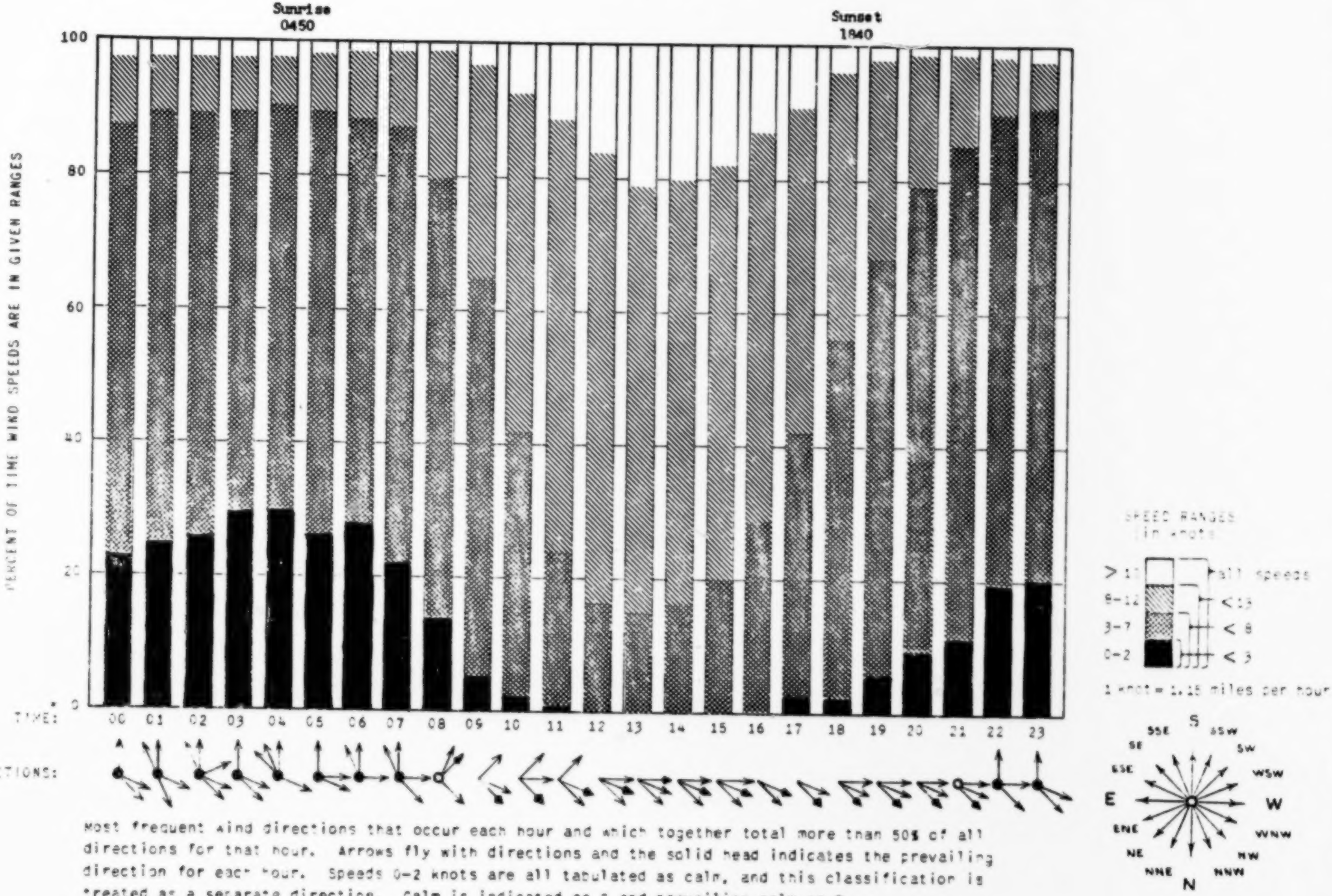
Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

FIGURE 17

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND
MAY 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

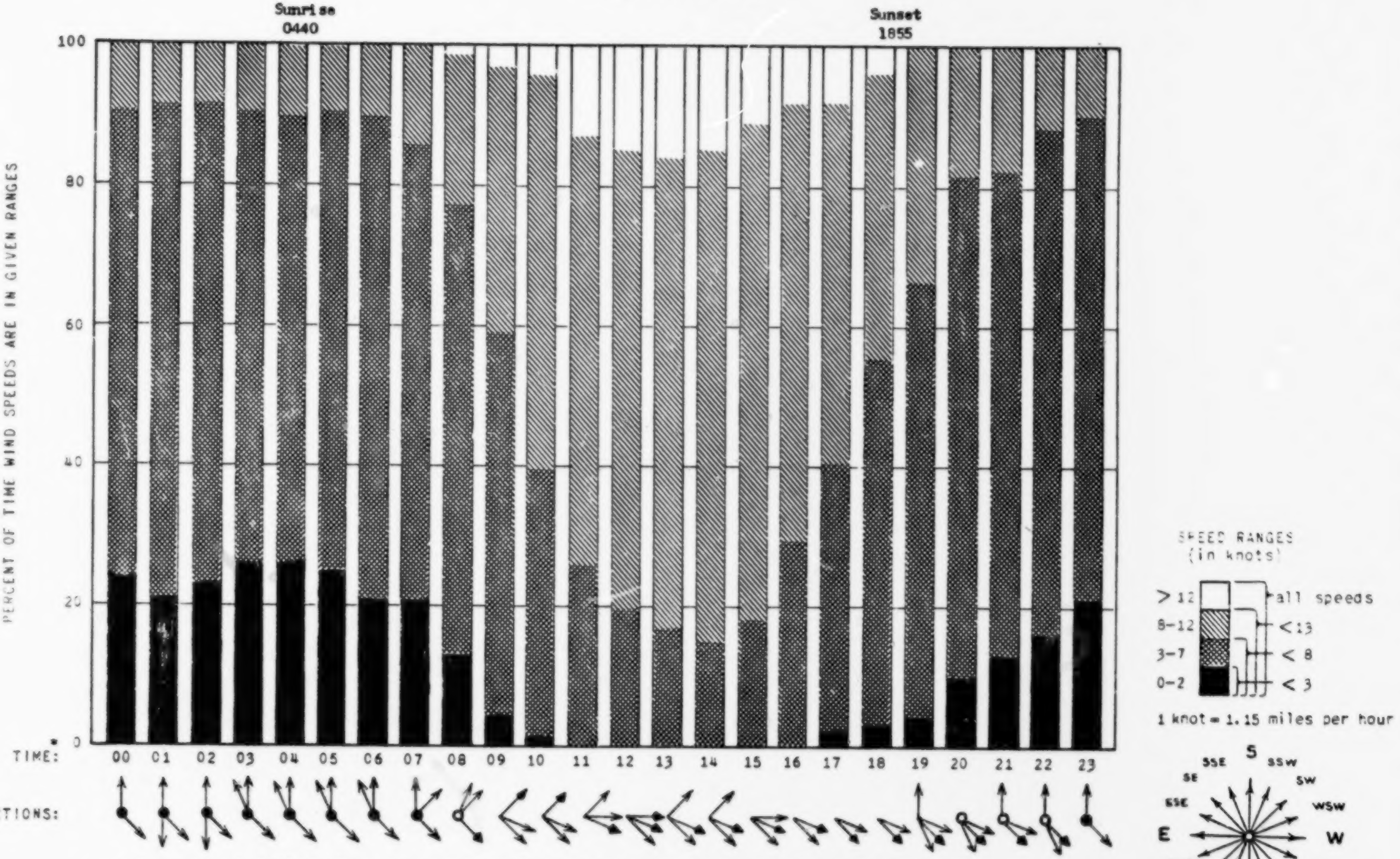
GCH

FIGURE 18

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

JUNE 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

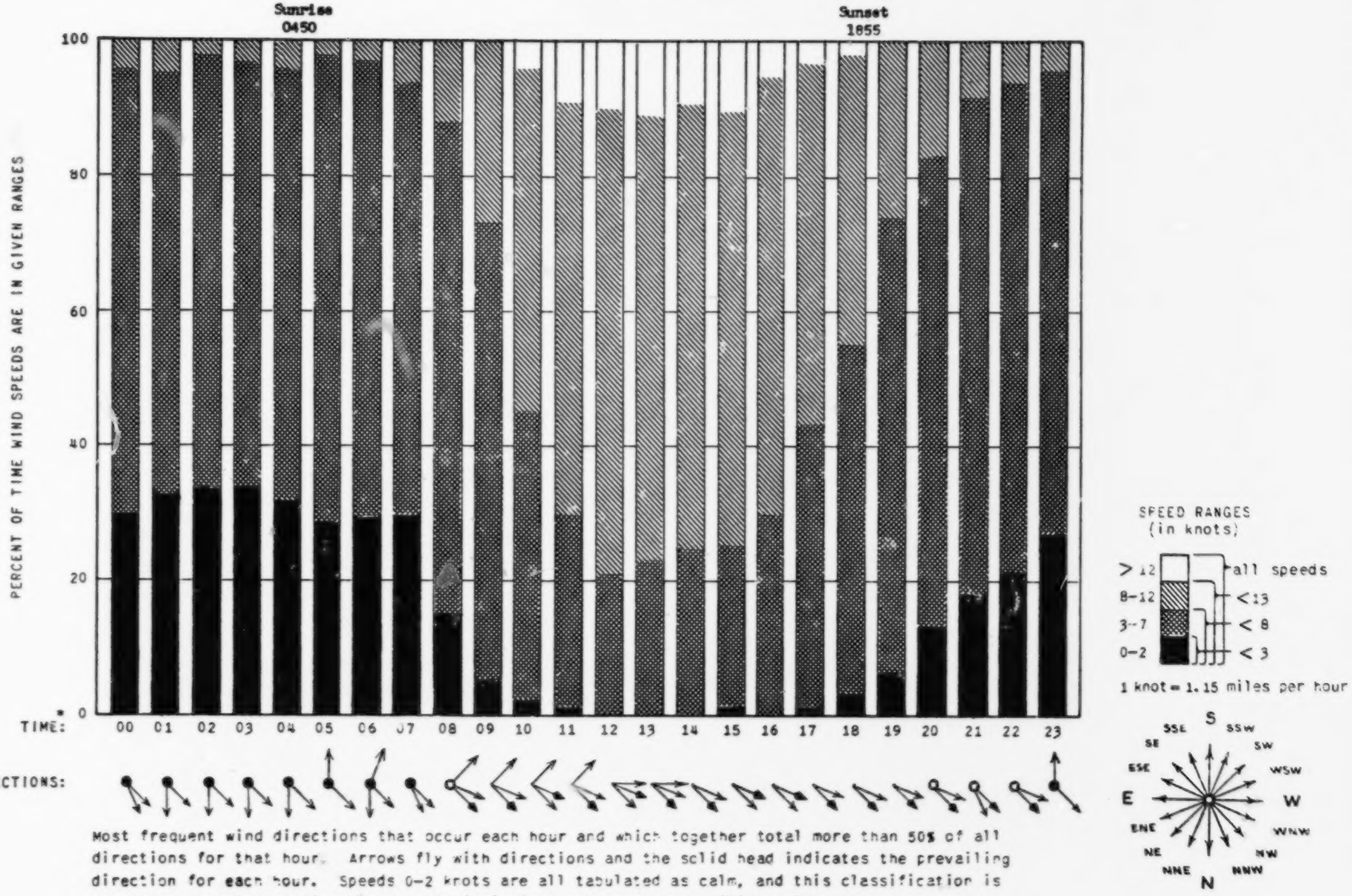
G.O.H.

FIGURE 19

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

JULY 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0–2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

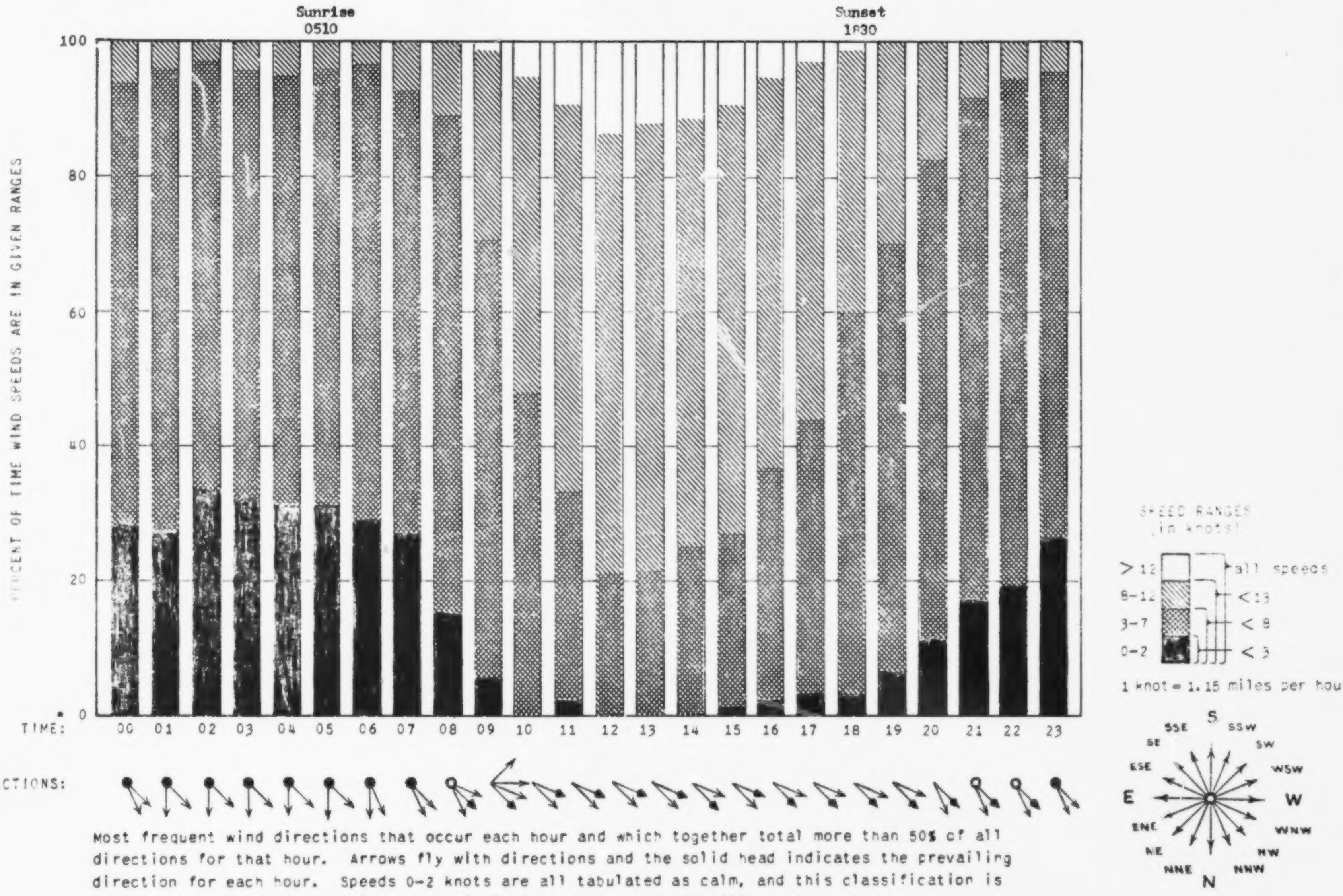
G.C.H.

FIGURE 20

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

AUGUST 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

G.C.H.

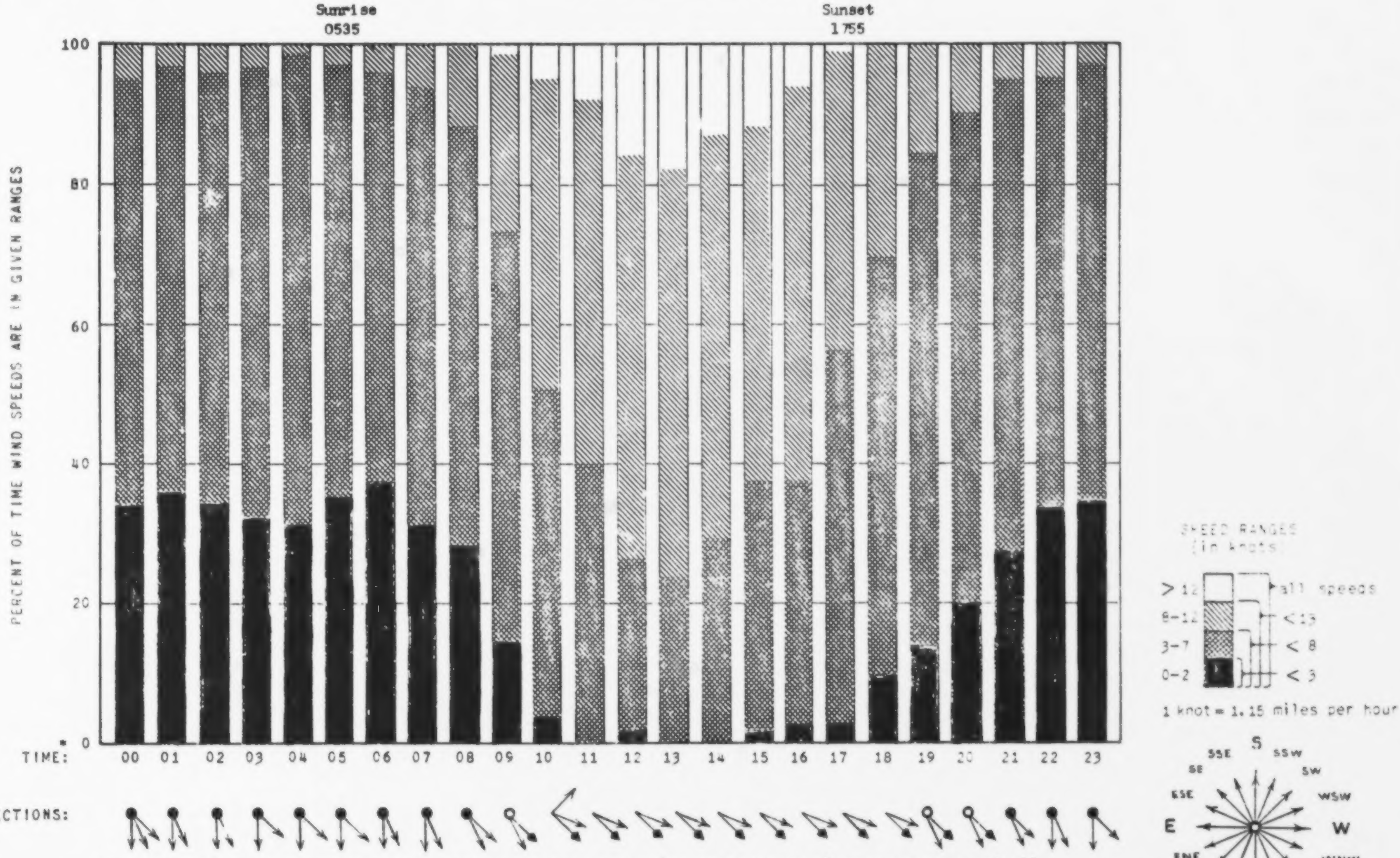
* Observations made during hour shown.

FIGURE 21

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

SEPTEMBER 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

G.C.H.

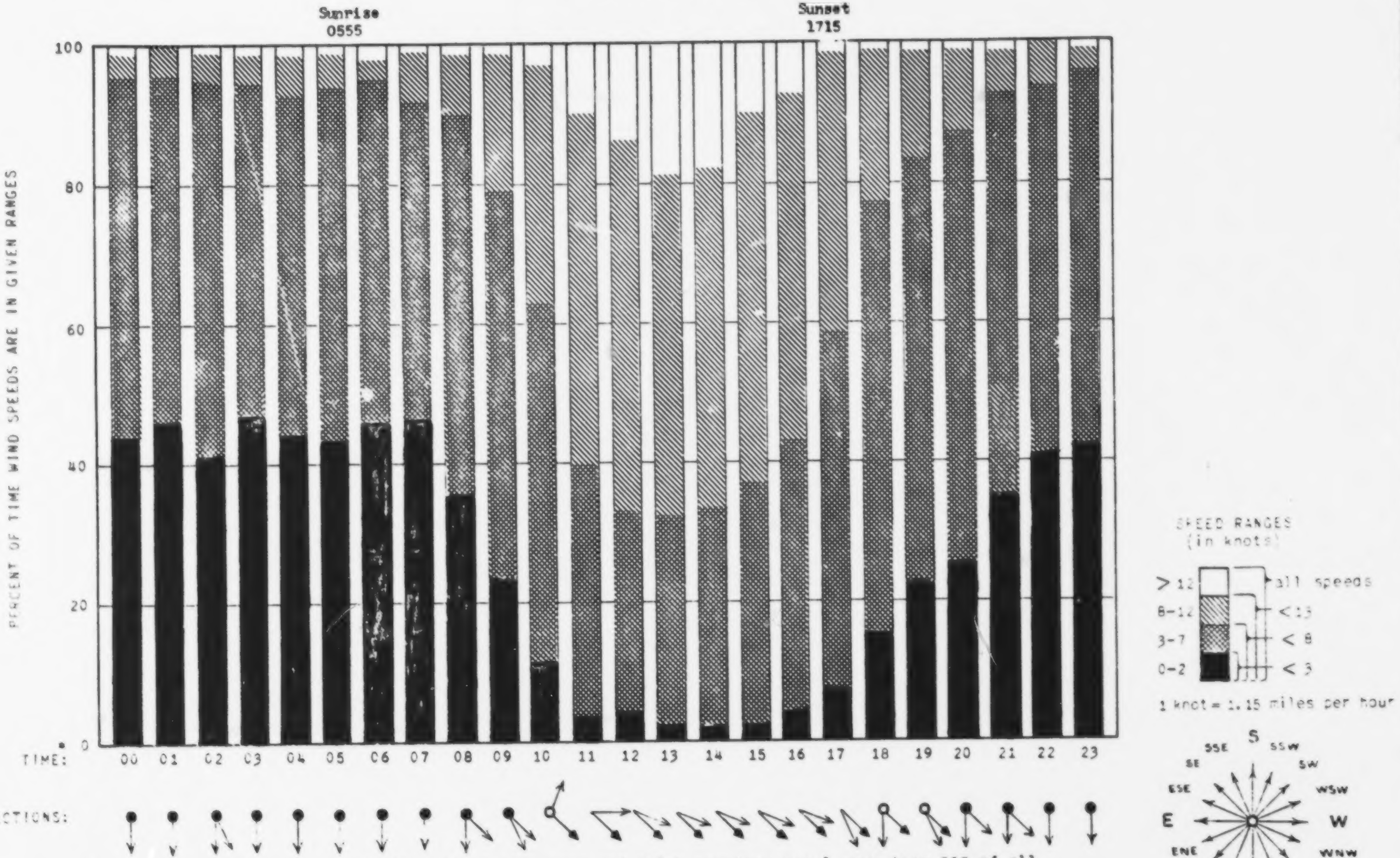
* Observations made during hour shown.

FIGURE 22

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

OCTOBER 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

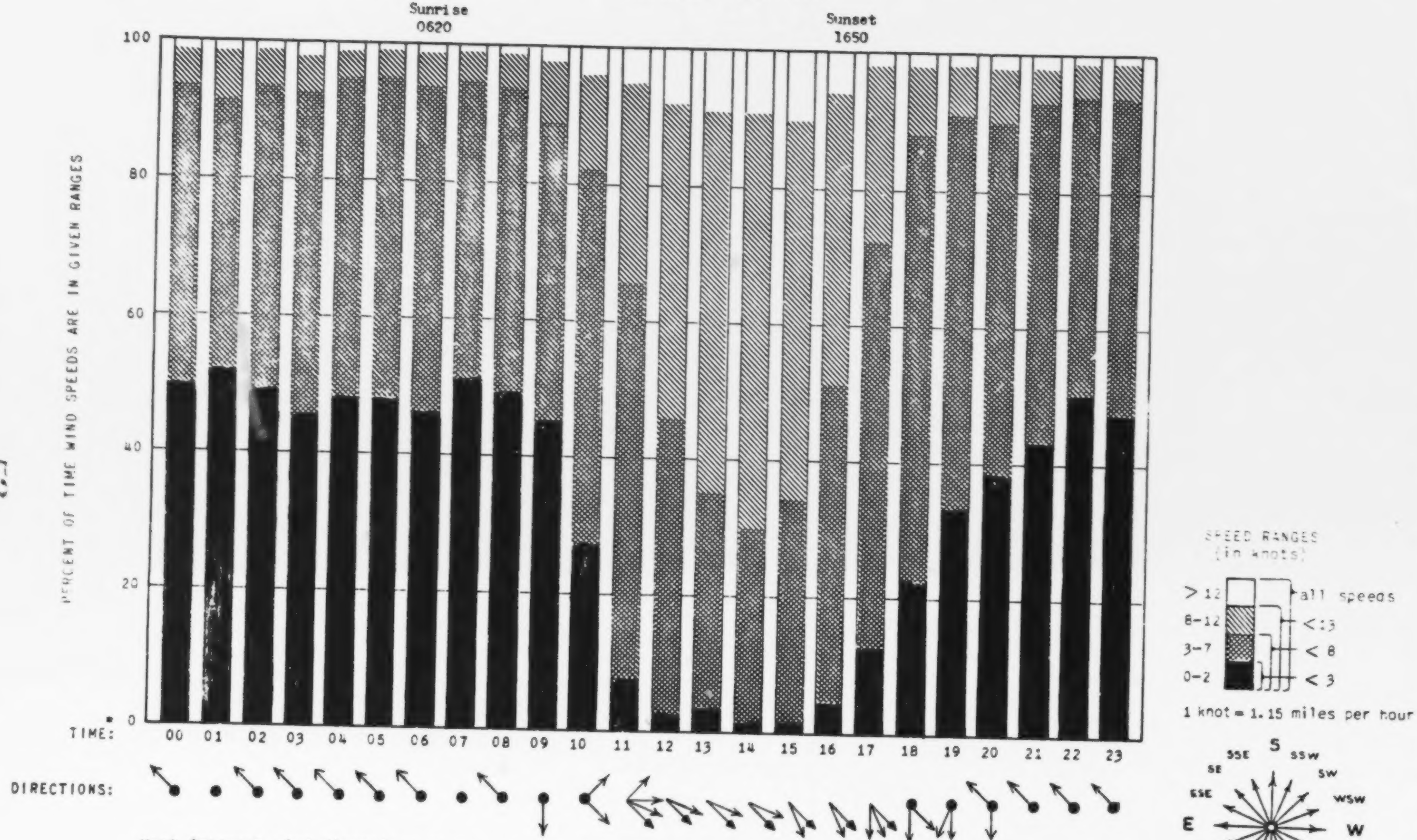
* Observations made during hour shown.

FIGURE 23

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

NOVEMBER 1945-1952



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

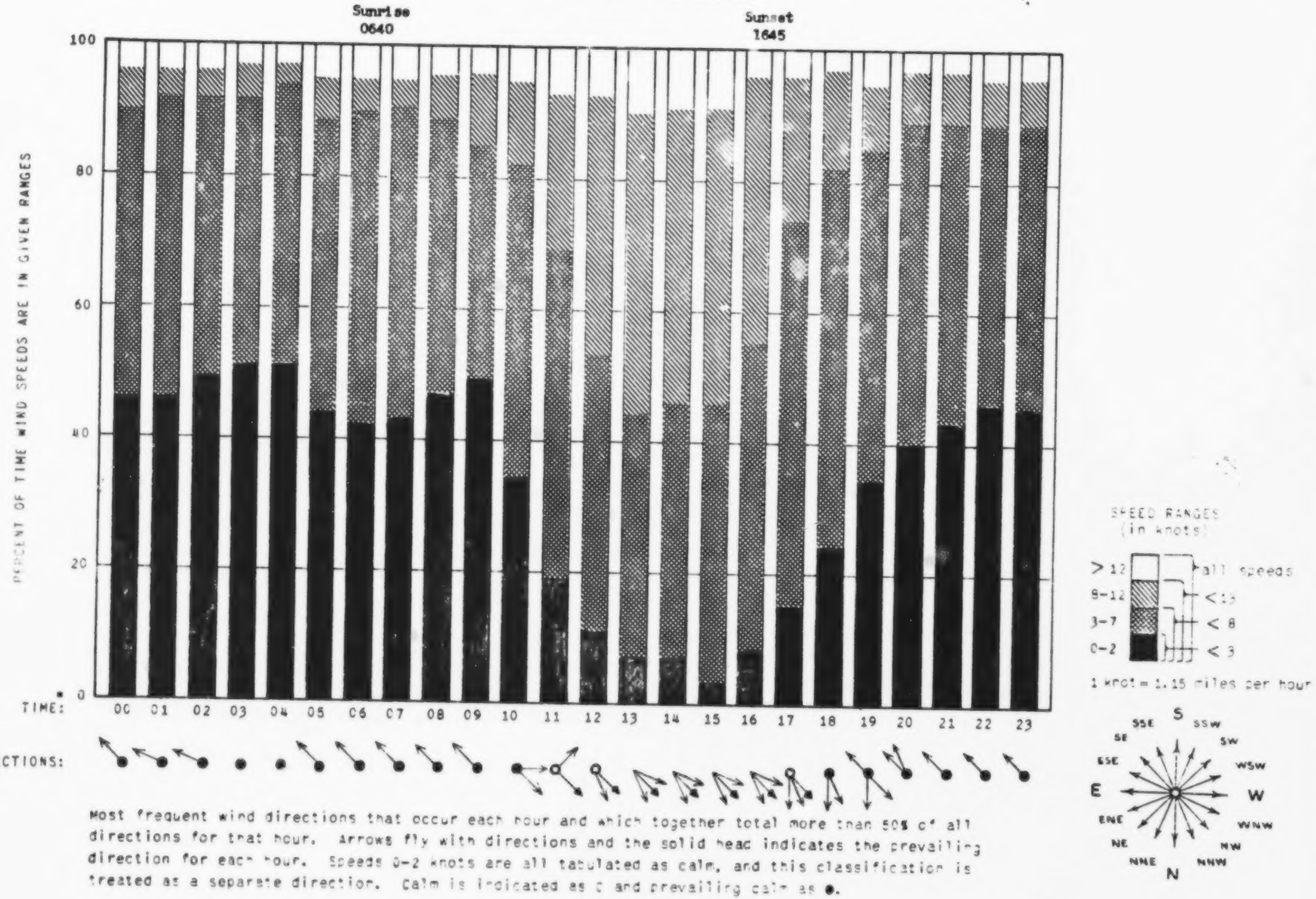
G.S.H.

FIGURE 24

HOURLY WIND SUMMARY

N.A.S. NORTH ISLAND

DECEMBER 1945-1952



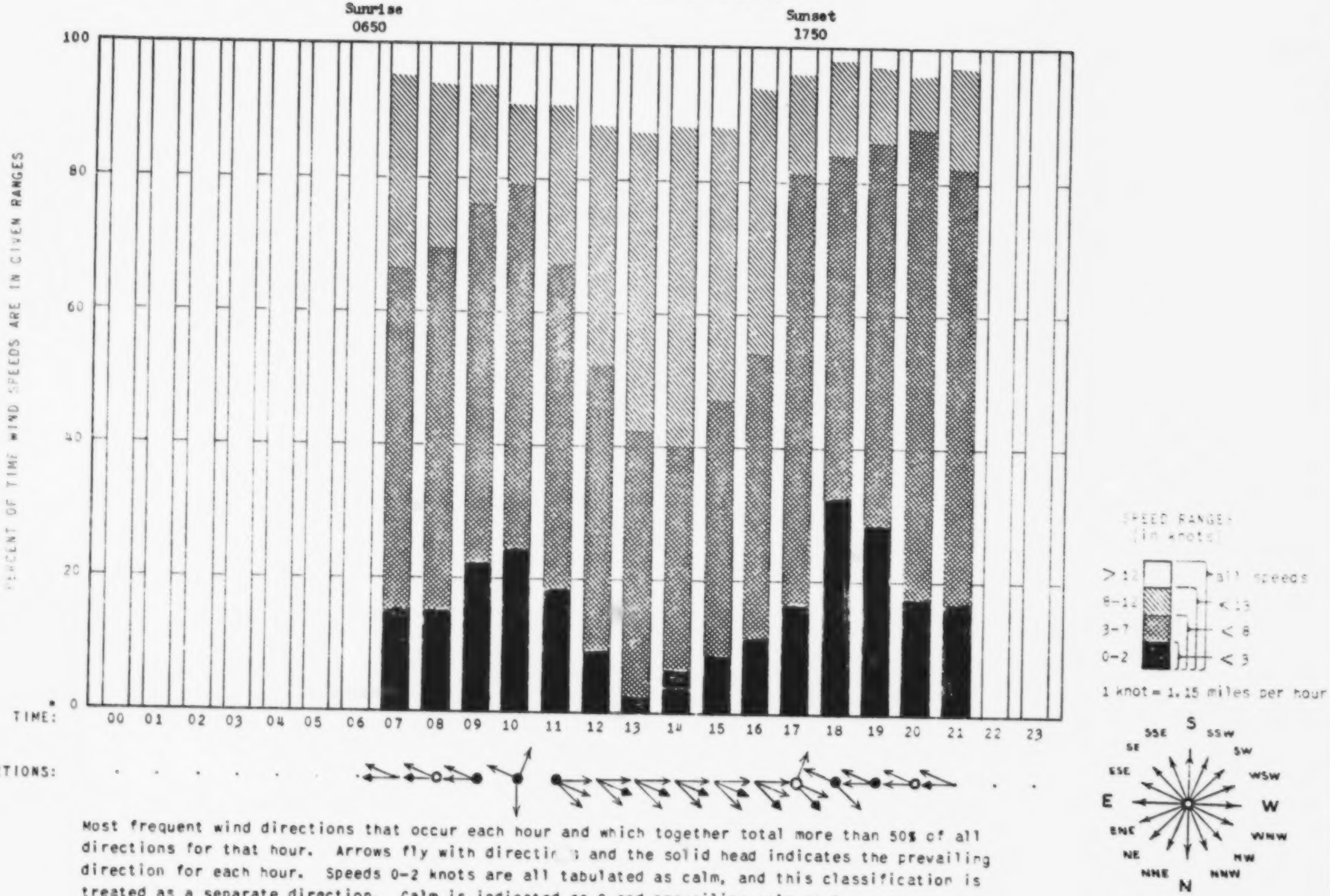
Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

G.C.H.

FIGURE 25

HOURLY WIND SUMMARY
N.A.S. REAM FIELD
JANUARY 1946-1948, 1952-1953

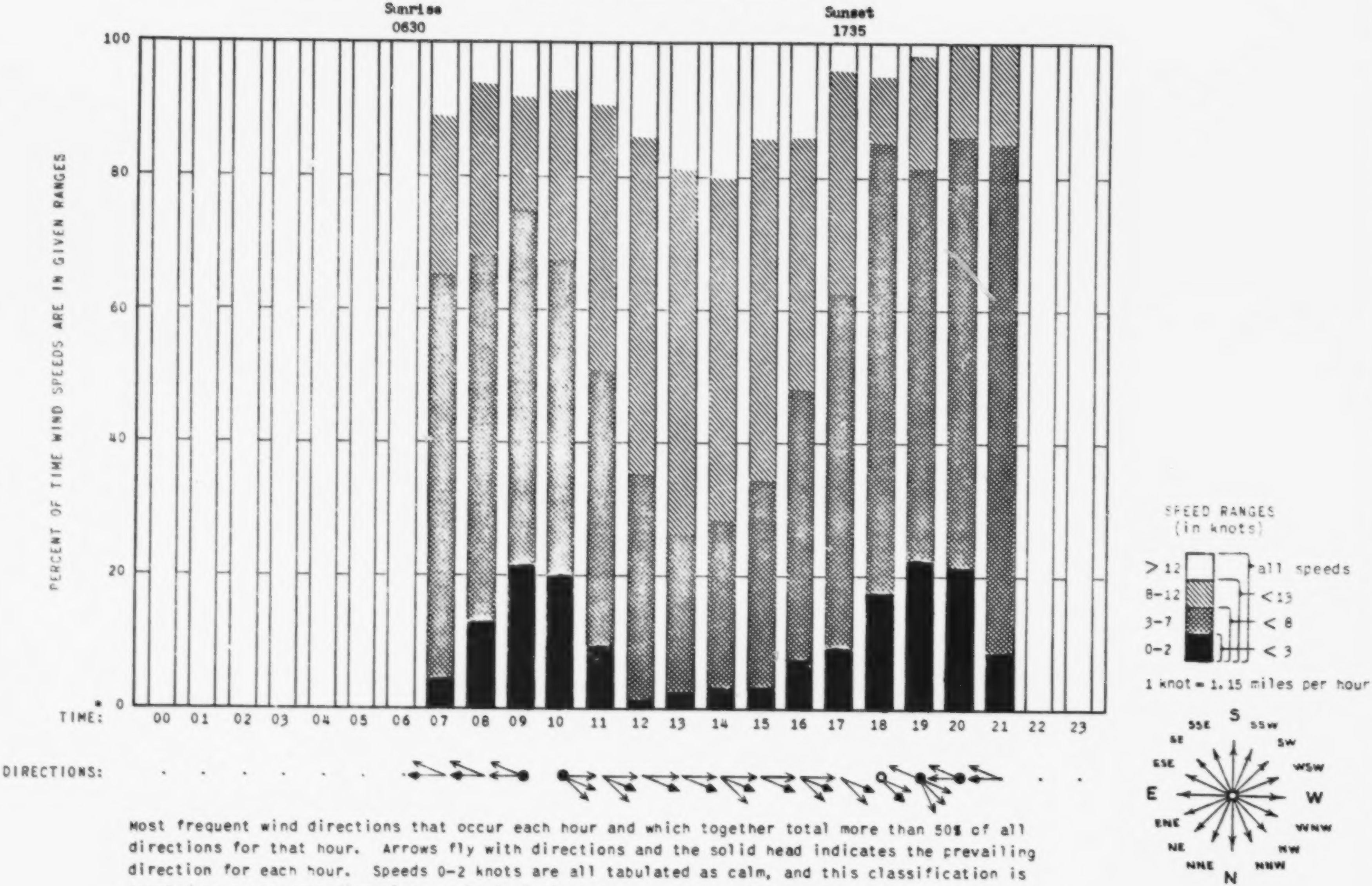


Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with direction and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

GCK

FIGURE 26



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

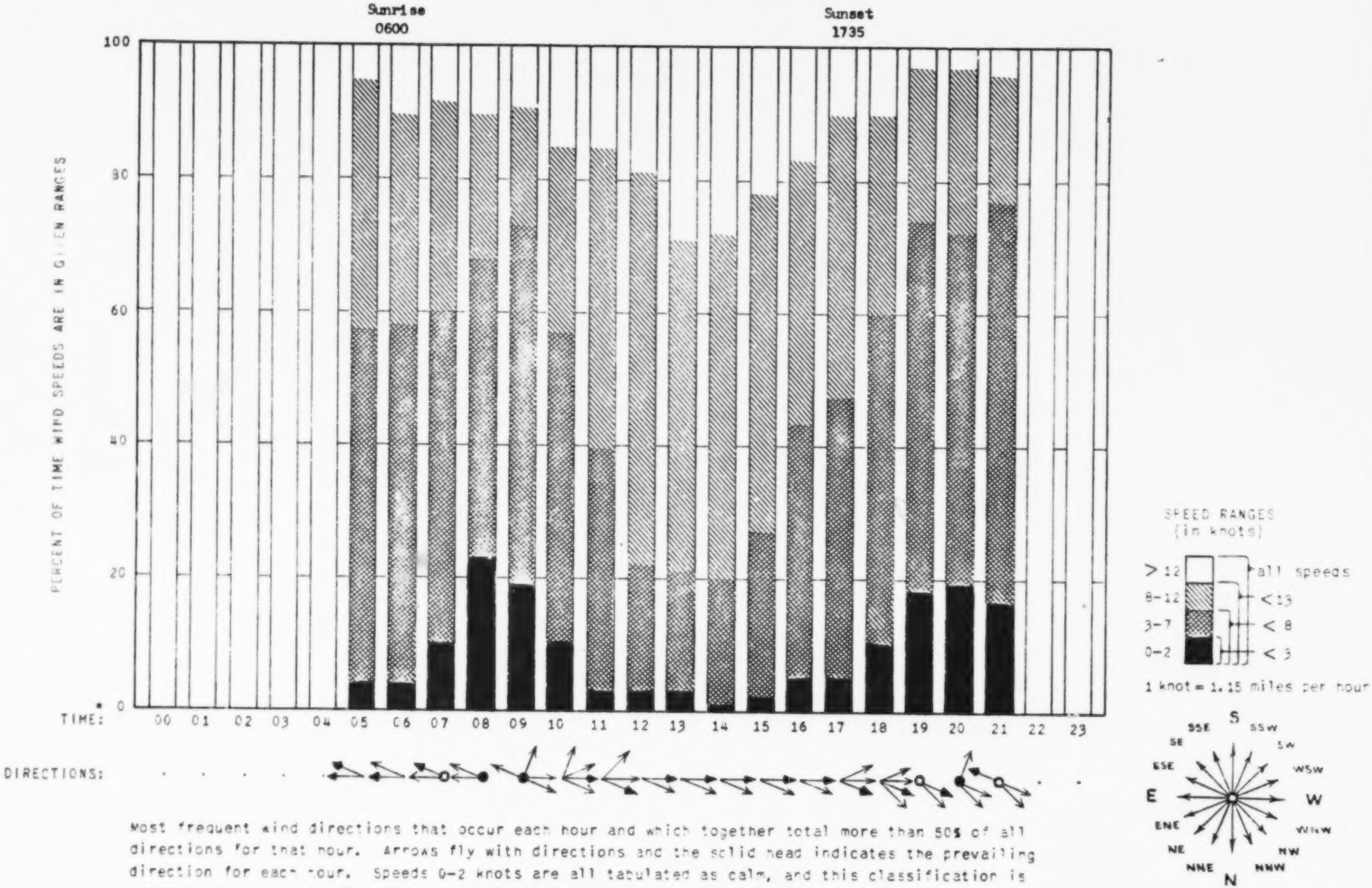
G.C.H.

FIGURE 27

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

MARCH 1946-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0–2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

* Observations made during hour shown.

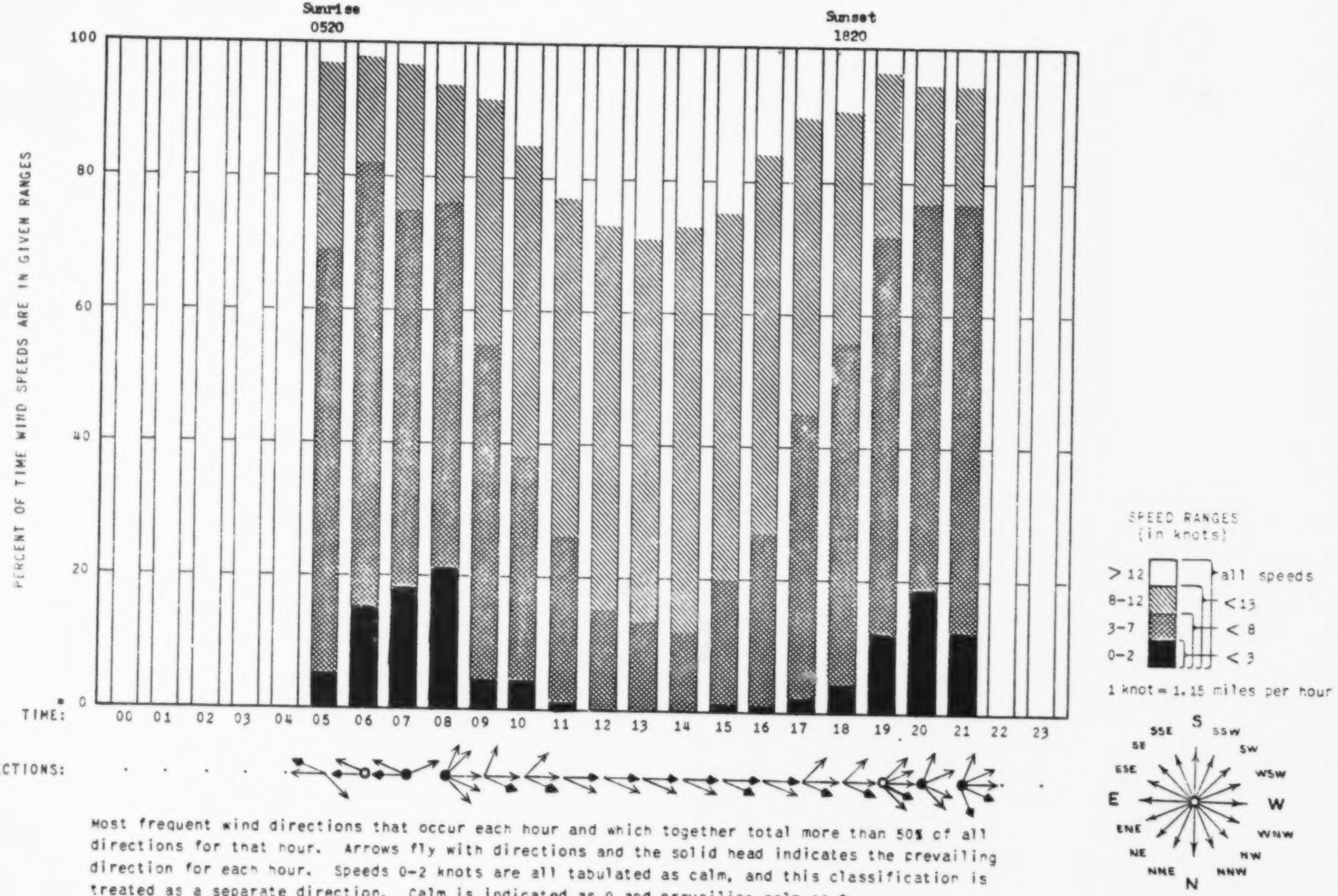
G.C.H

FIGURE 28

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

APRIL 1945-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

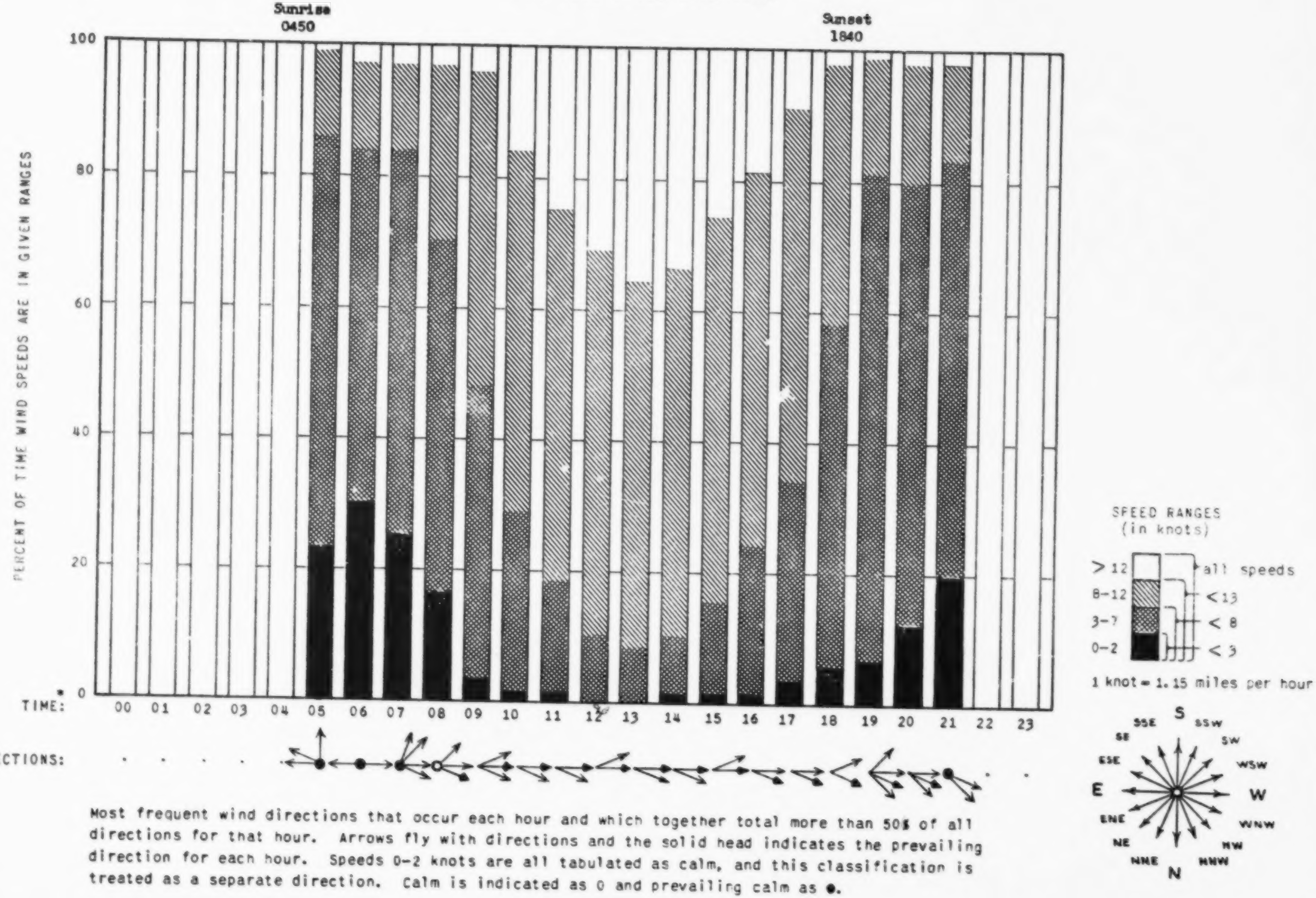
* Observations made during hour shown.

FIGURE 29

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

MAY 1945-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

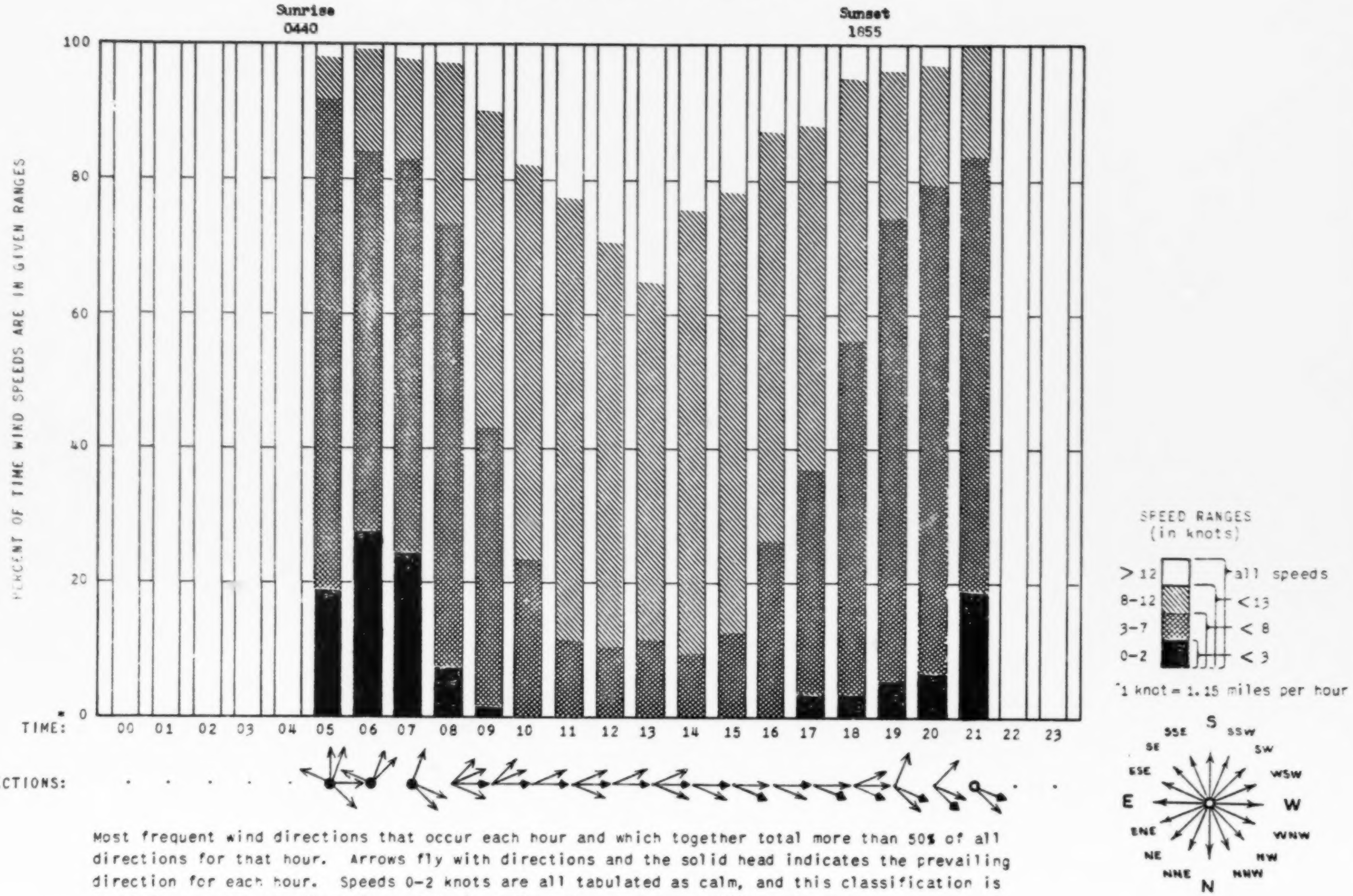
* Observations made during hour shown.

FIGURE 30

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

JUNE 1945-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

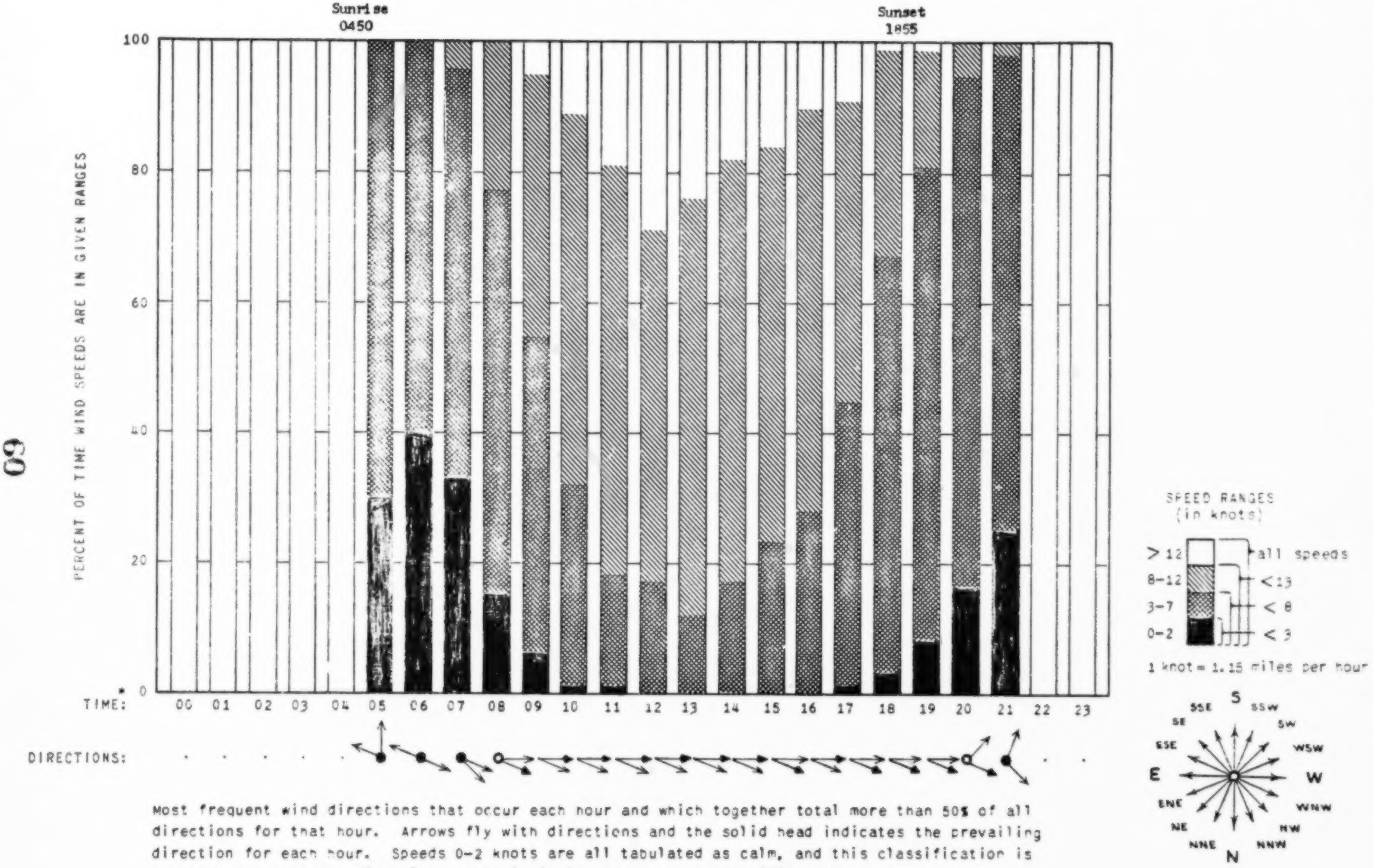
* Observations made during hour shown.

FIGURE 31

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

JULY 1945-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

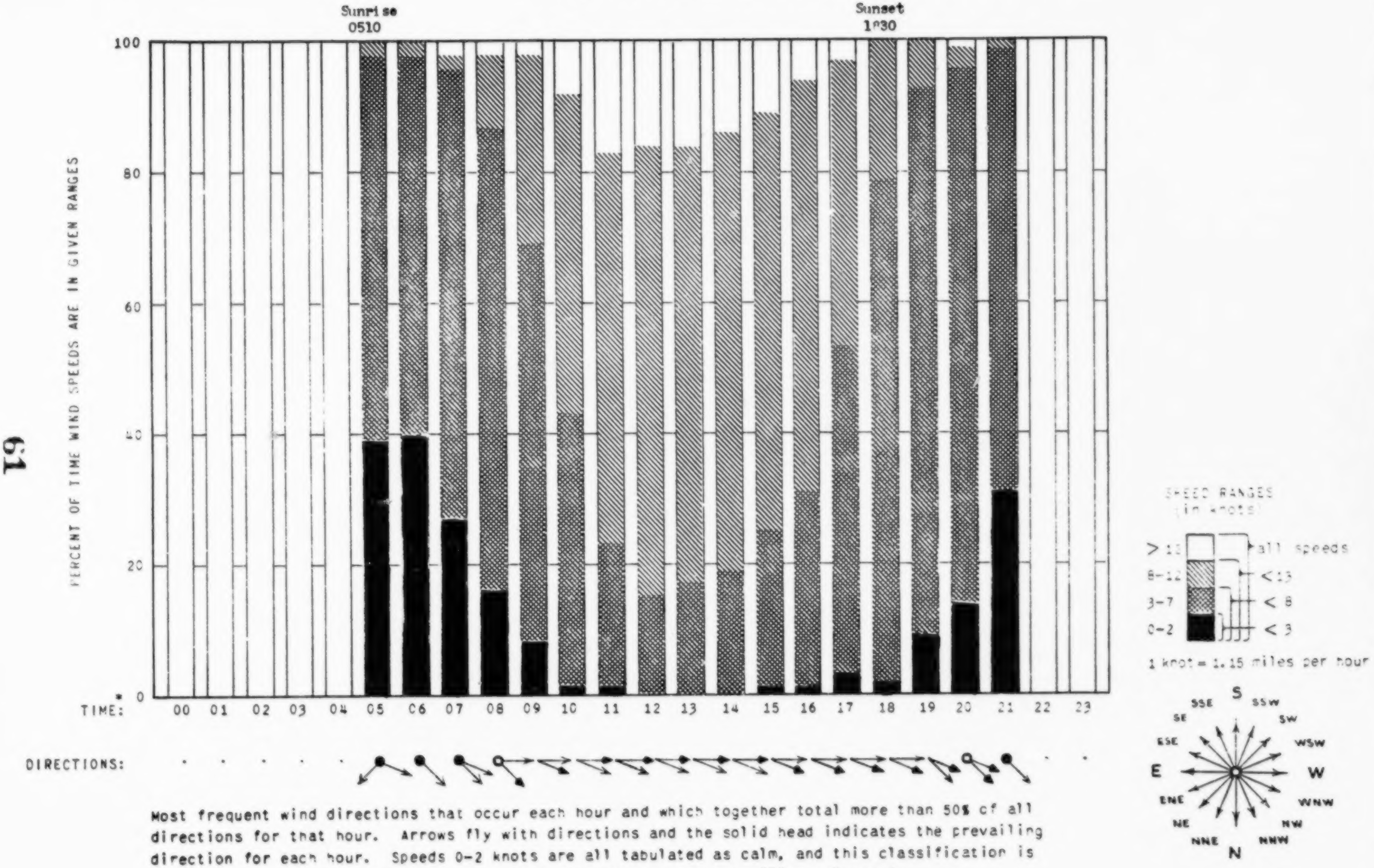
* Observations made during hour shown.

FIGURE 32

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

AUGUST 1945-1948, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as 0 and prevailing calm as ●.

* Observations made during hour shown.

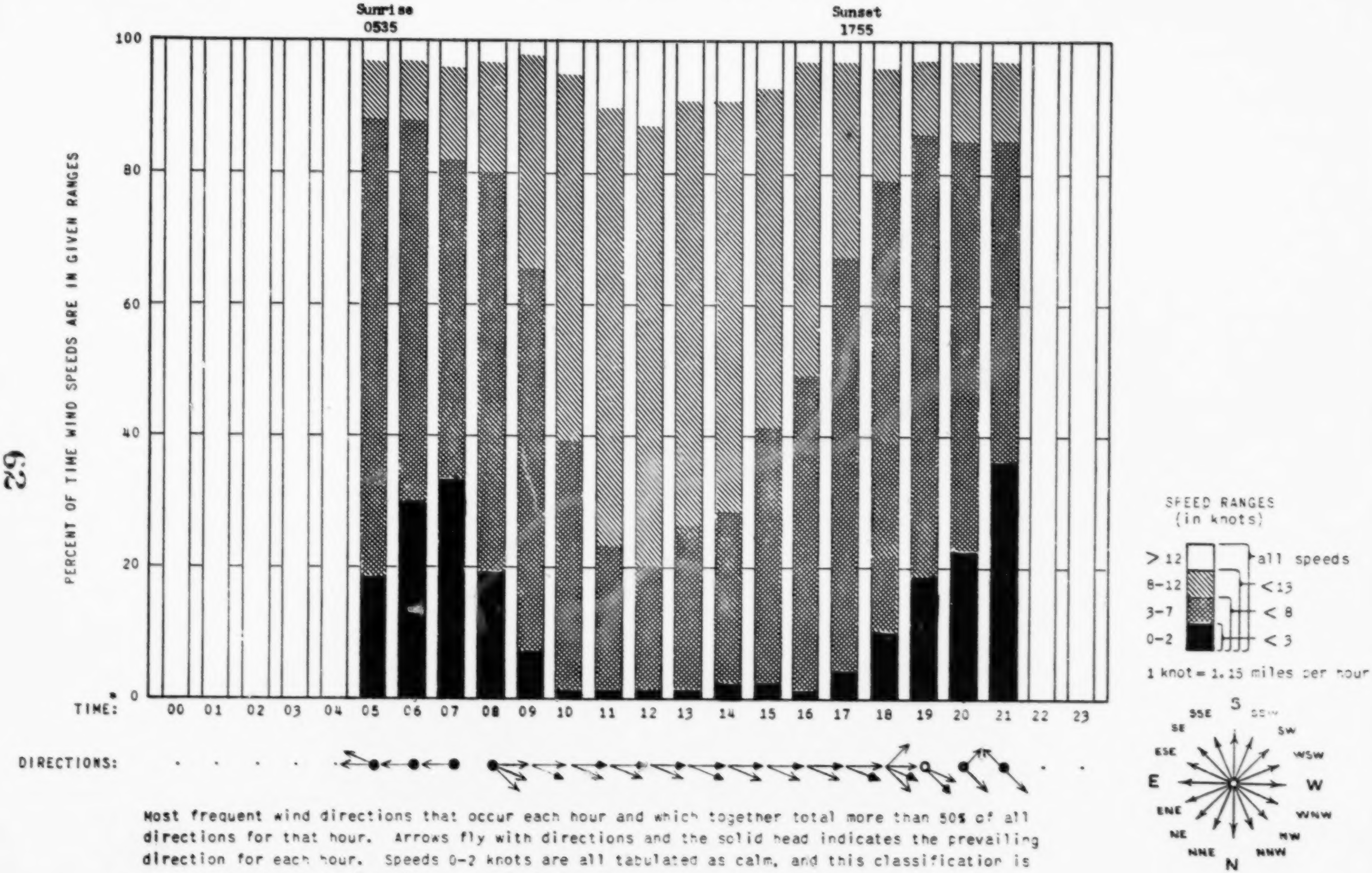
G.C.H

FIGURE 33

HOURLY WIND SUMMARY

N.A.S REAM FIELD

SEPTEMBER 1945-1947, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as C and prevailing calm as ●.

* Observations made during hour shown.

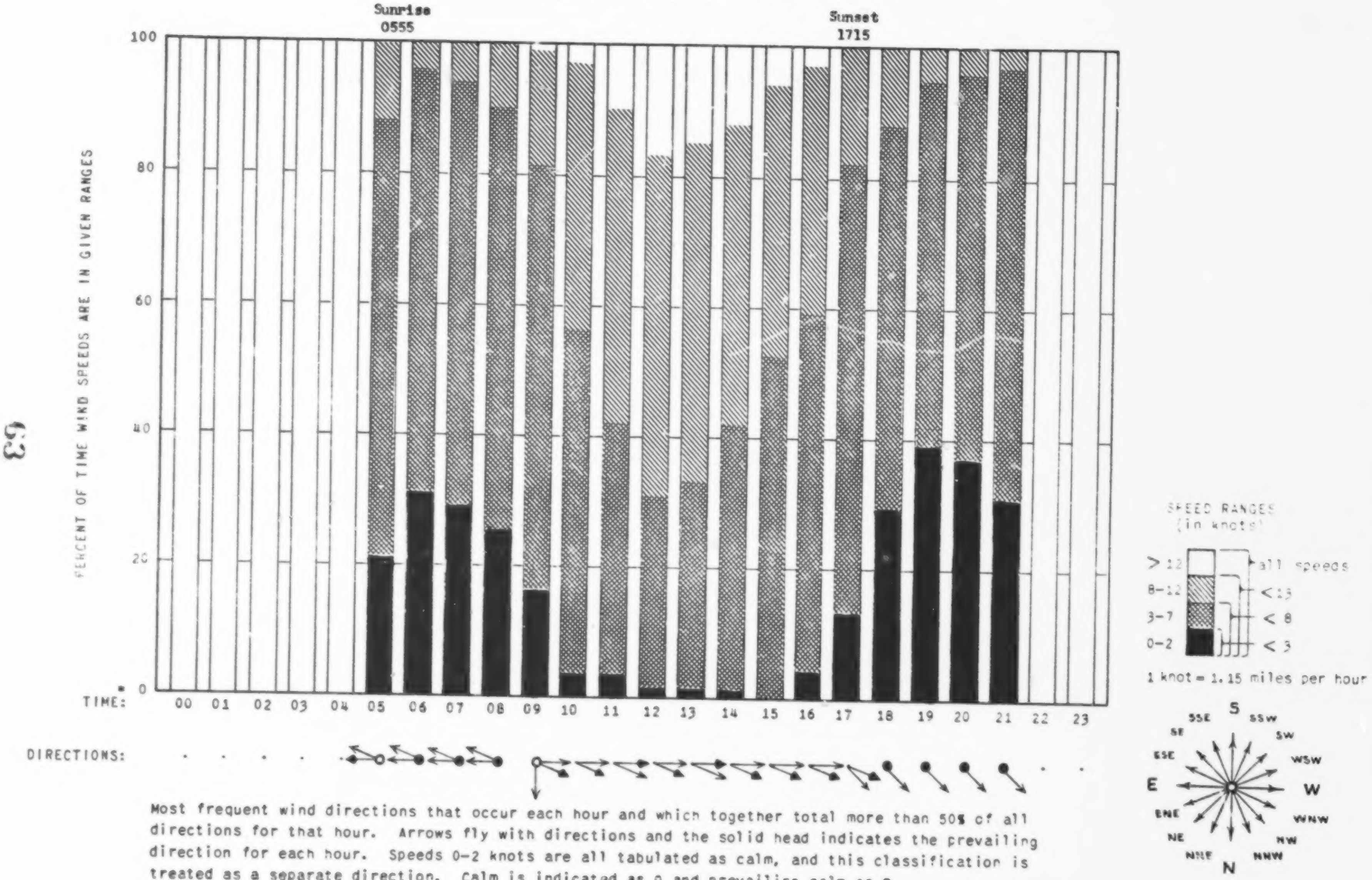
[illegible]

FIGURE 34

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

OCTOBER 1945-1947, 1952-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as O and prevailing calm as ●.

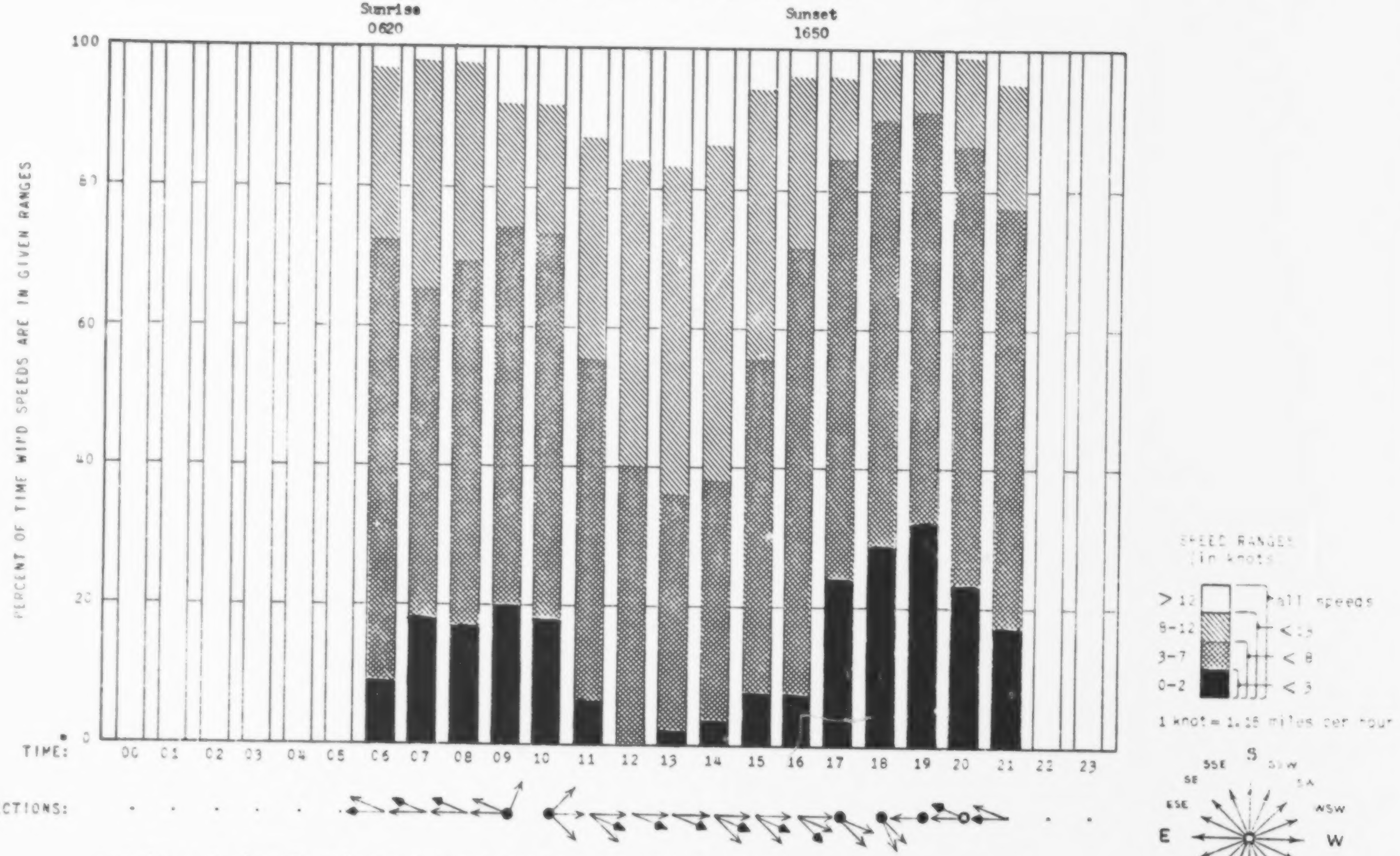
* Observations made during hour shown.

FIGURE 35

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

NOVEMBER 1945-1947, 1951-1953



Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as ○ and prevailing calm as ●.

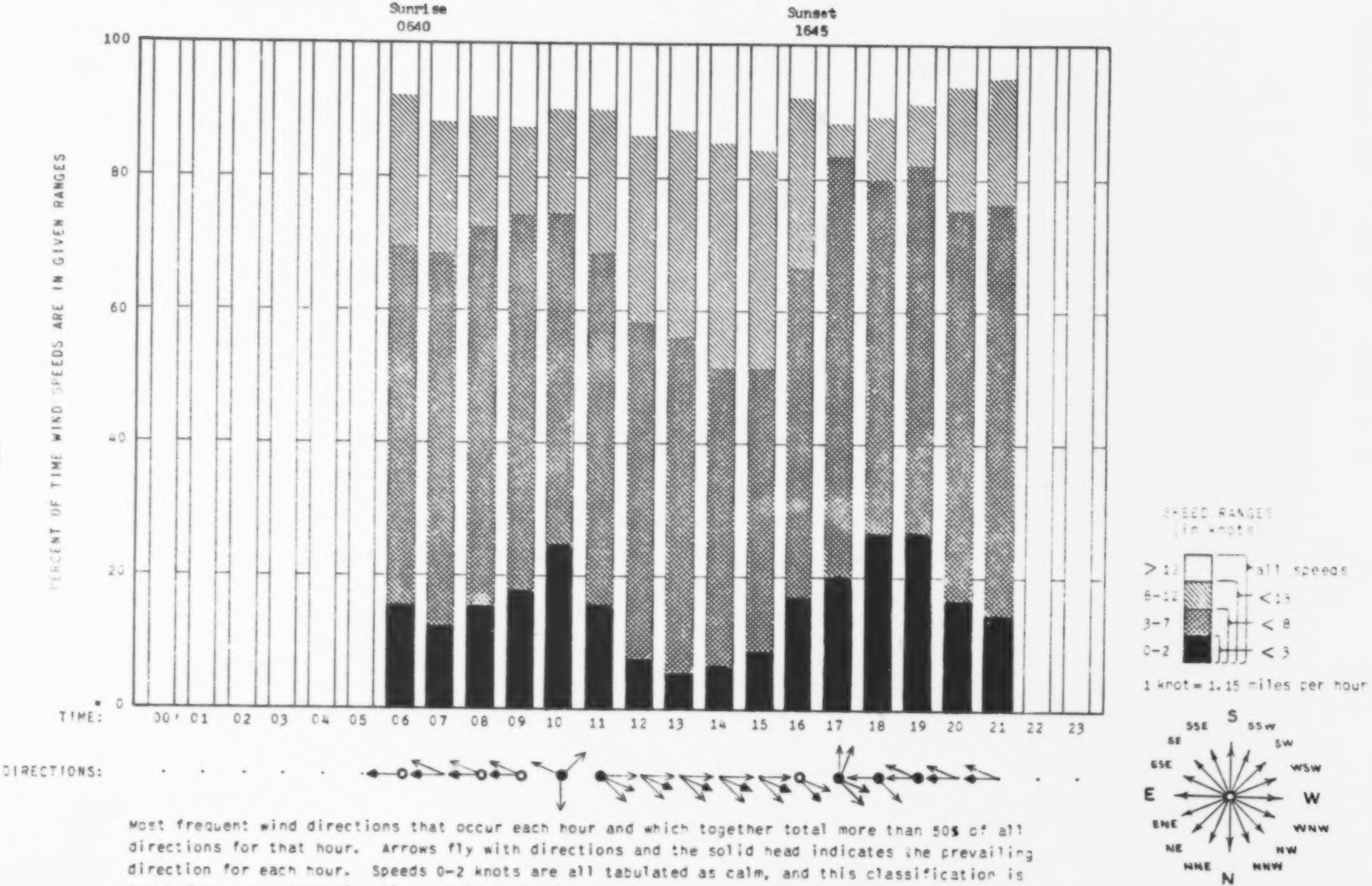
* Observations made during hour shown.

FIGURE 36

HOURLY WIND SUMMARY

N.A.S. REAM FIELD

DECEMBER 1945-1947, 1951-1953



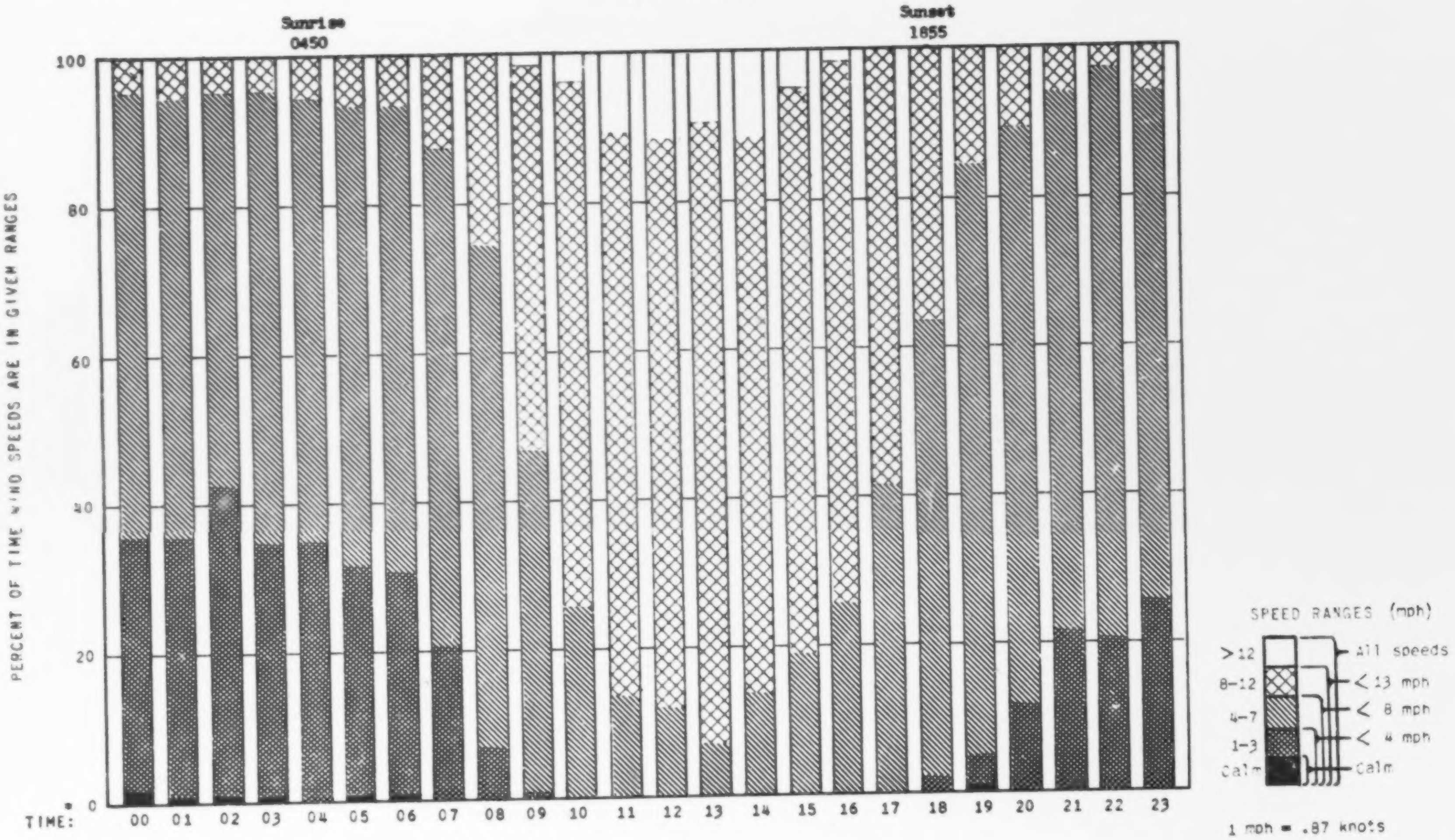
Most frequent wind directions that occur each hour and which together total more than 50% of all directions for that hour. Arrows fly with directions and the solid head indicates the prevailing direction for each hour. Speeds 0-2 knots are all tabulated as calm, and this classification is treated as a separate direction. Calm is indicated as o and prevailing calm as ●.

* Observations made during hour shown.

GCH

FIGURE 37

HOURLY* WIND SPEED SUMMARY
LINDBERGH FIELD
JULY 1949-1954



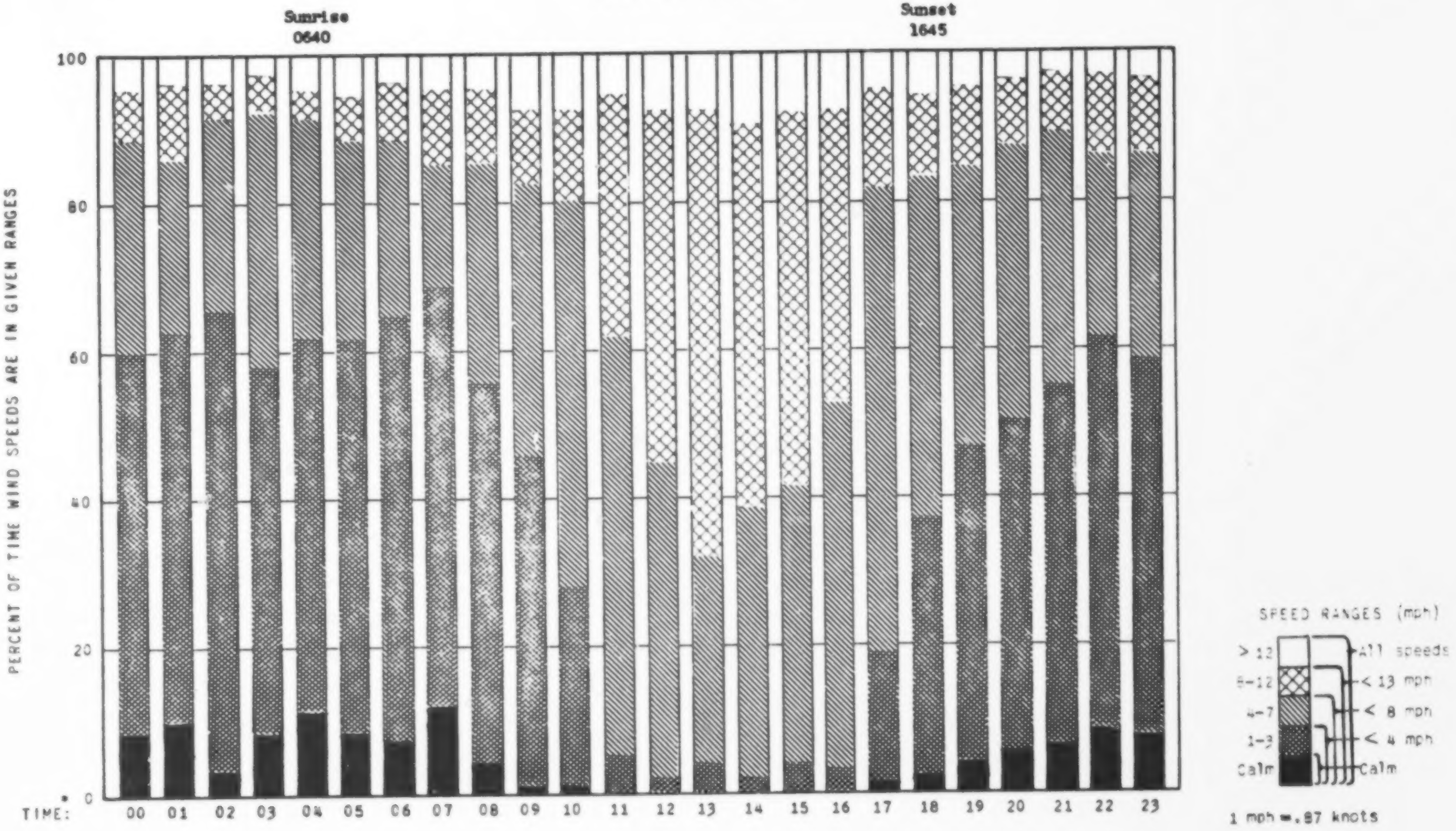
* Observations at 20 minutes past hour shown

FIGURE 38

HOURLY WIND SPEED SUMMARY

LINDBERGH FIELD

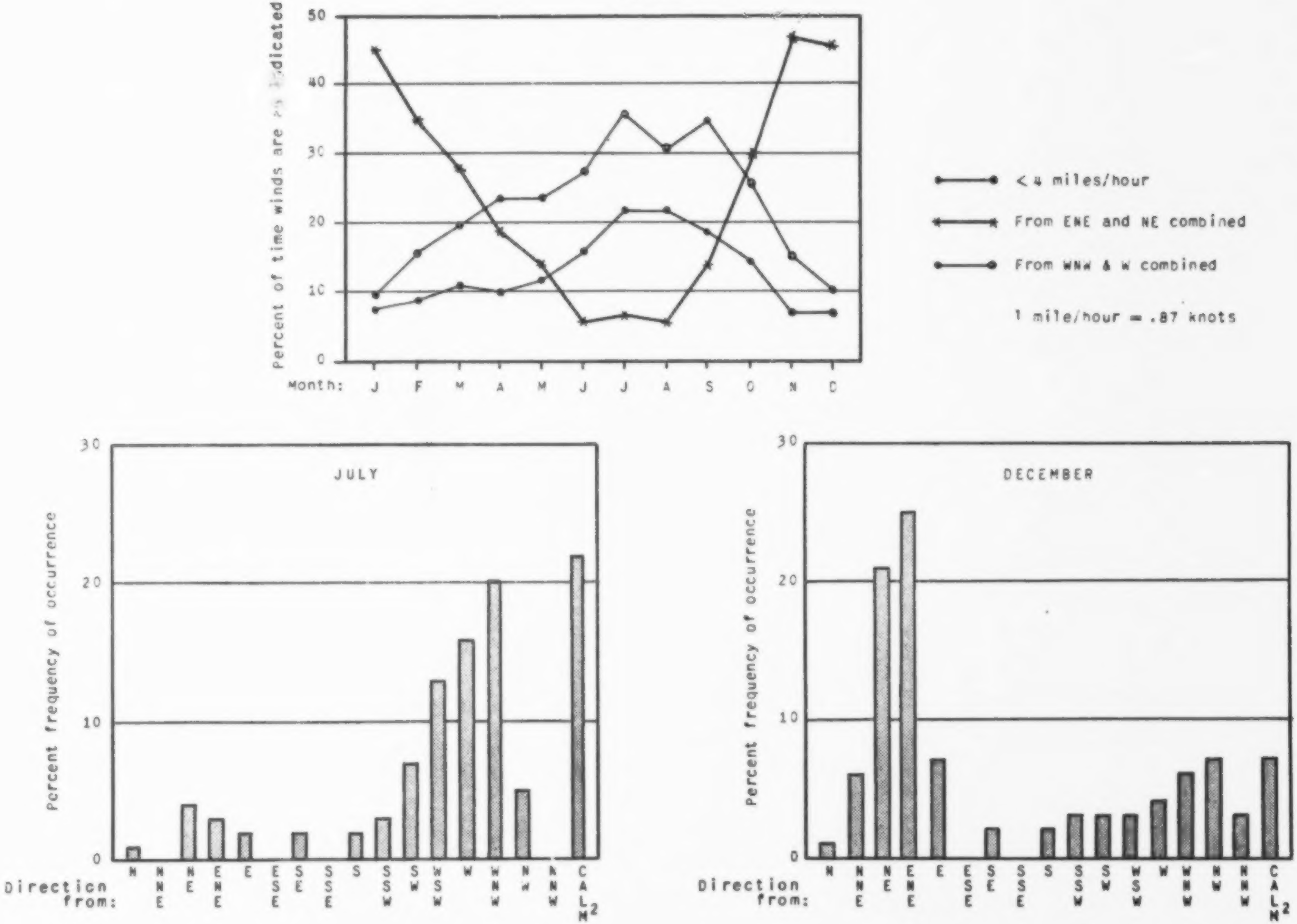
DECEMBER 1949-1954



* Observations at 20 minutes past hour shown

FIGURE 39

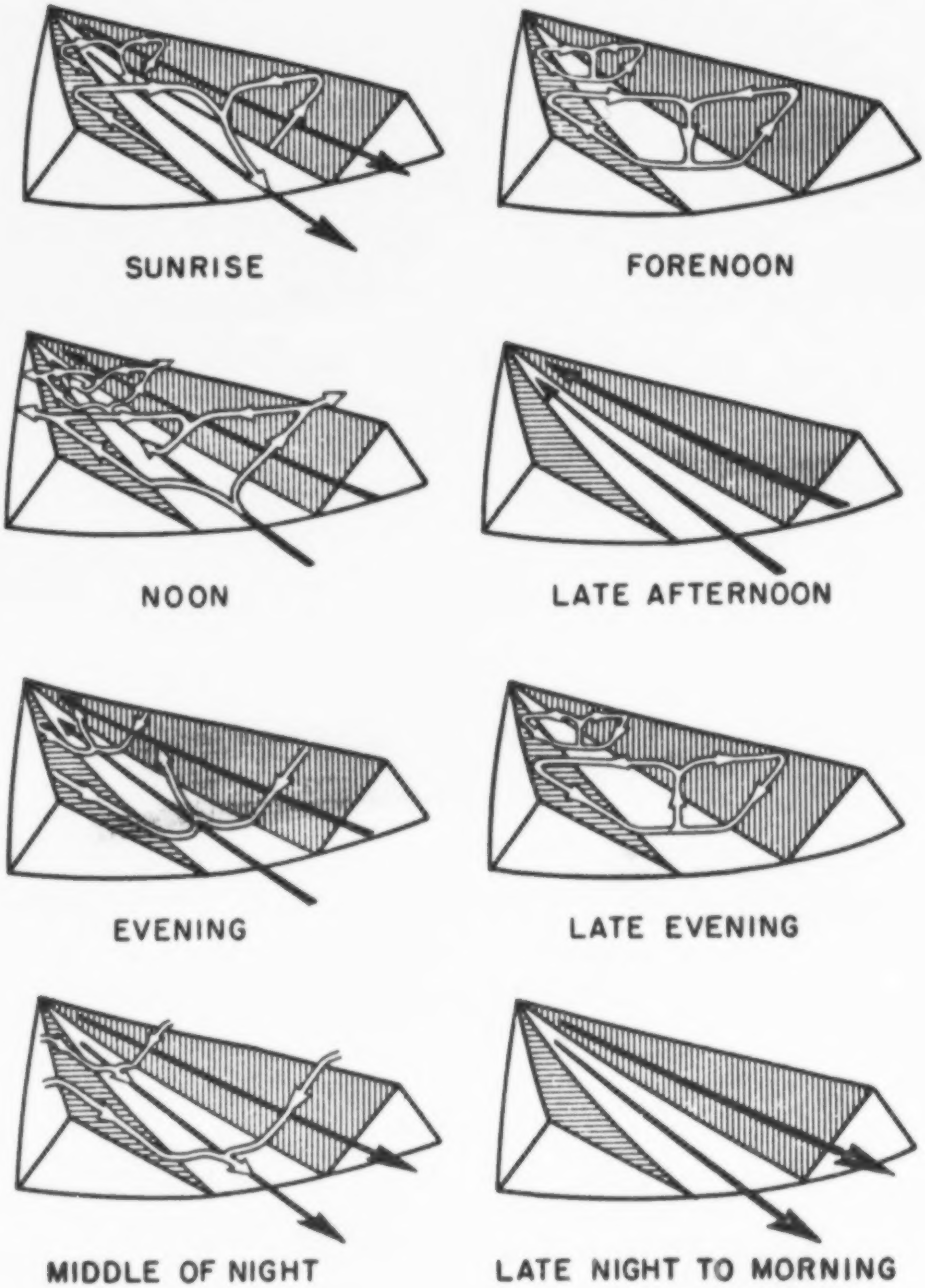
MONTHLY SUMMARY OF HOURLY WINDS
OCEANSIDE
1934-1938



1 Observer bias for 8 primary directions corrected by "odd-even" method

2 Calm here includes all winds less than 4 miles/hour

Figure 40



SUNRISE

FORENOON

NOON

LATE AFTERNOON

EVENING

LATE EVENING

MIDDLE OF NIGHT

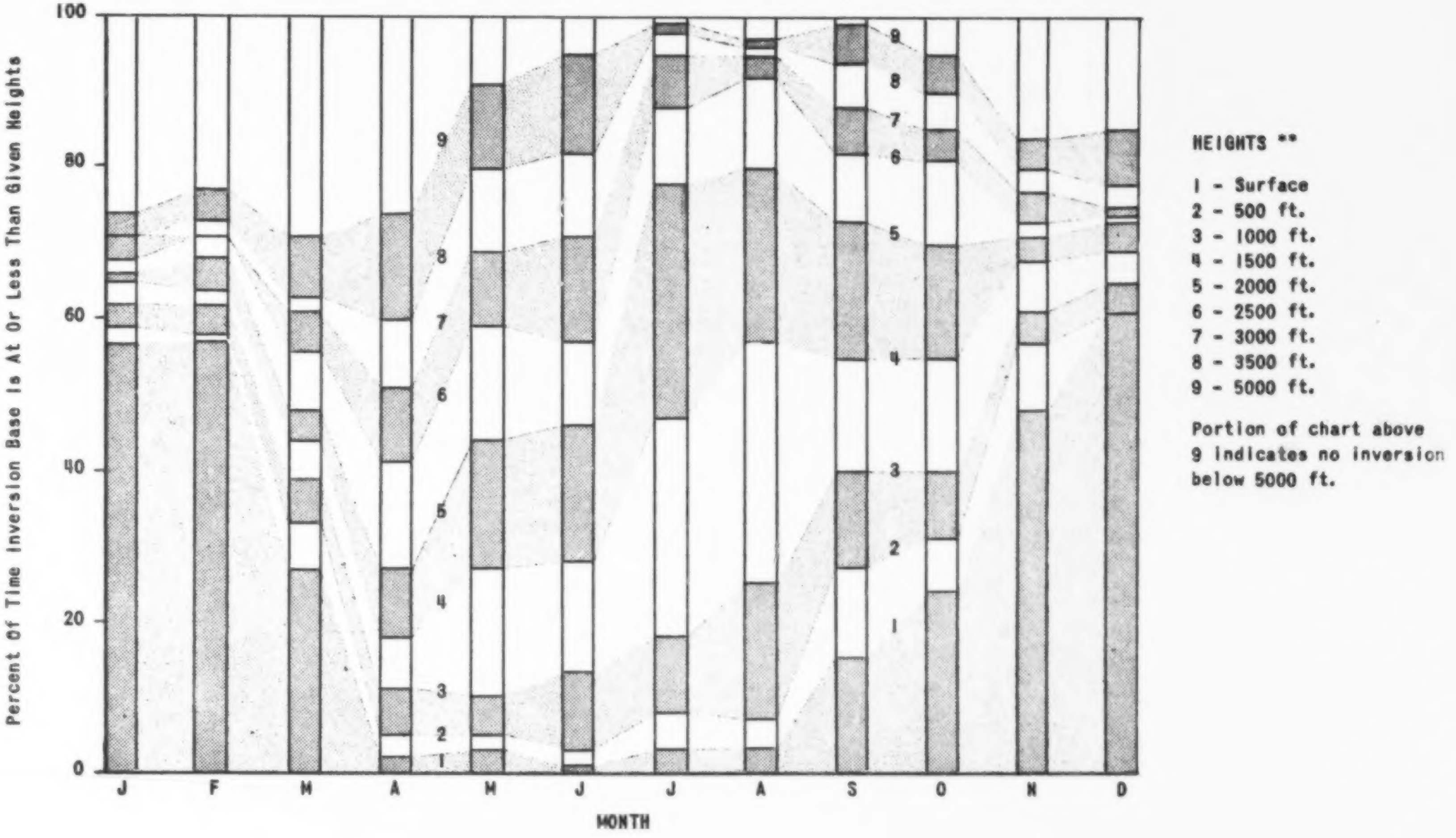
LATE NIGHT TO MORNING

Idealized Representation of
Circulation That Might Be Expected in
a Typical Valley (after Defant (10))

Figure 41

HEIGHT OF INVERSION BASE

N.A.S. NORTH ISLAND
OBSERVATIONS AT 0700 PST



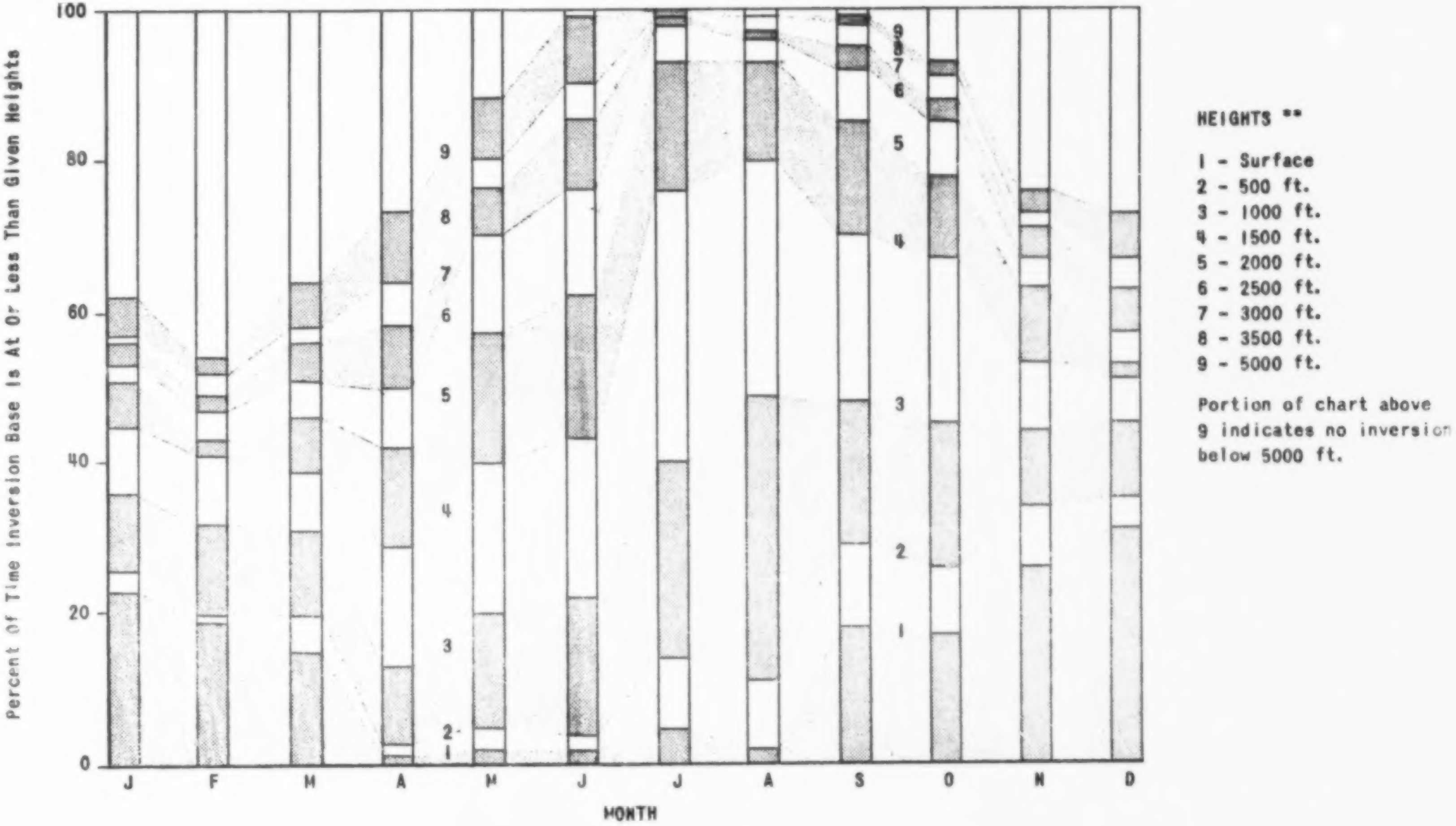
* Based on 5 years of record during 1950-1956.

** Shading is for clarity only.

Figure 42

HEIGHT OF INVERSION BASE

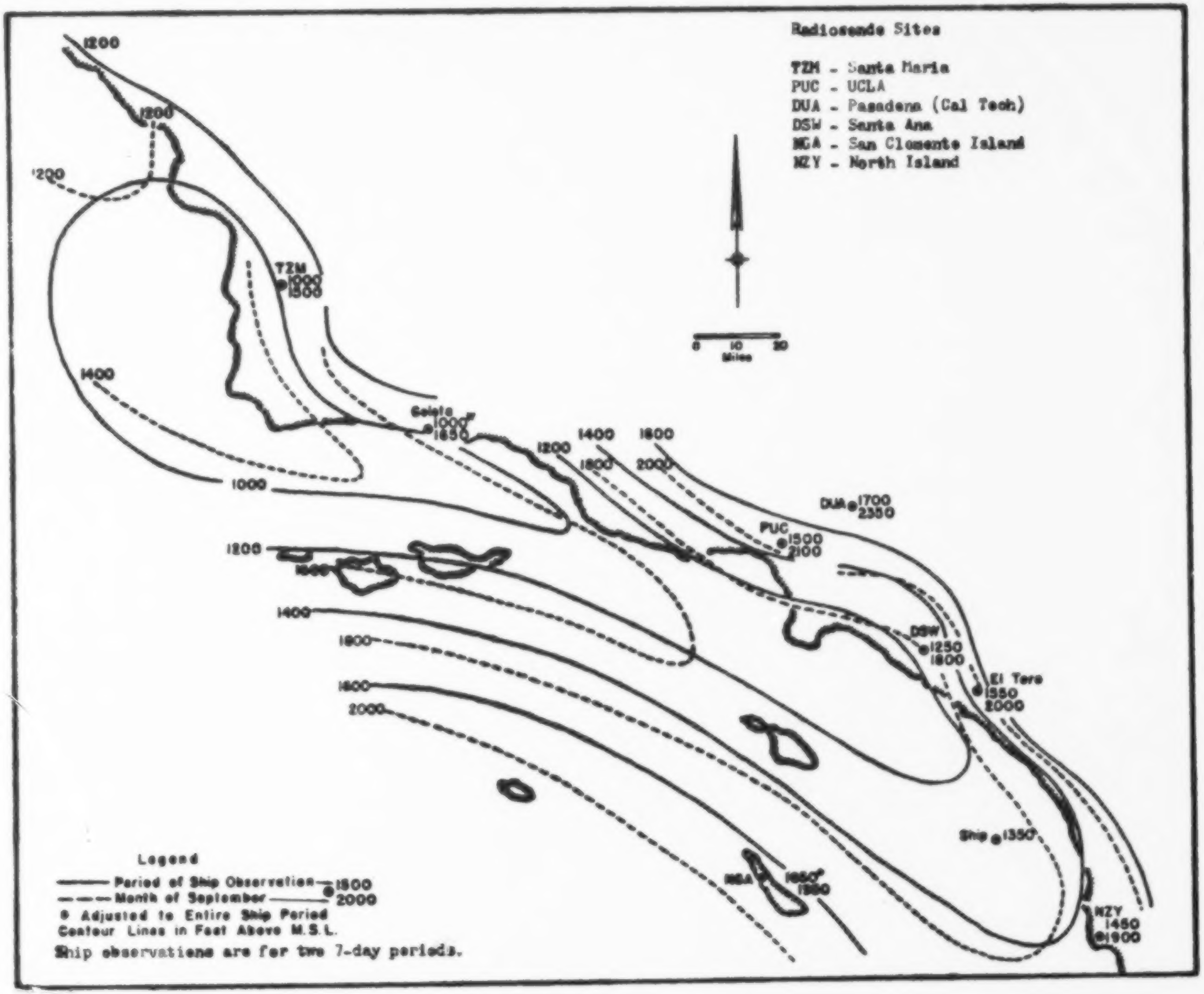
N.A.S. NORTH ISLAND
OBSERVATIONS AT 1900 PST



* Based on 5 years of record during 1950-1956.

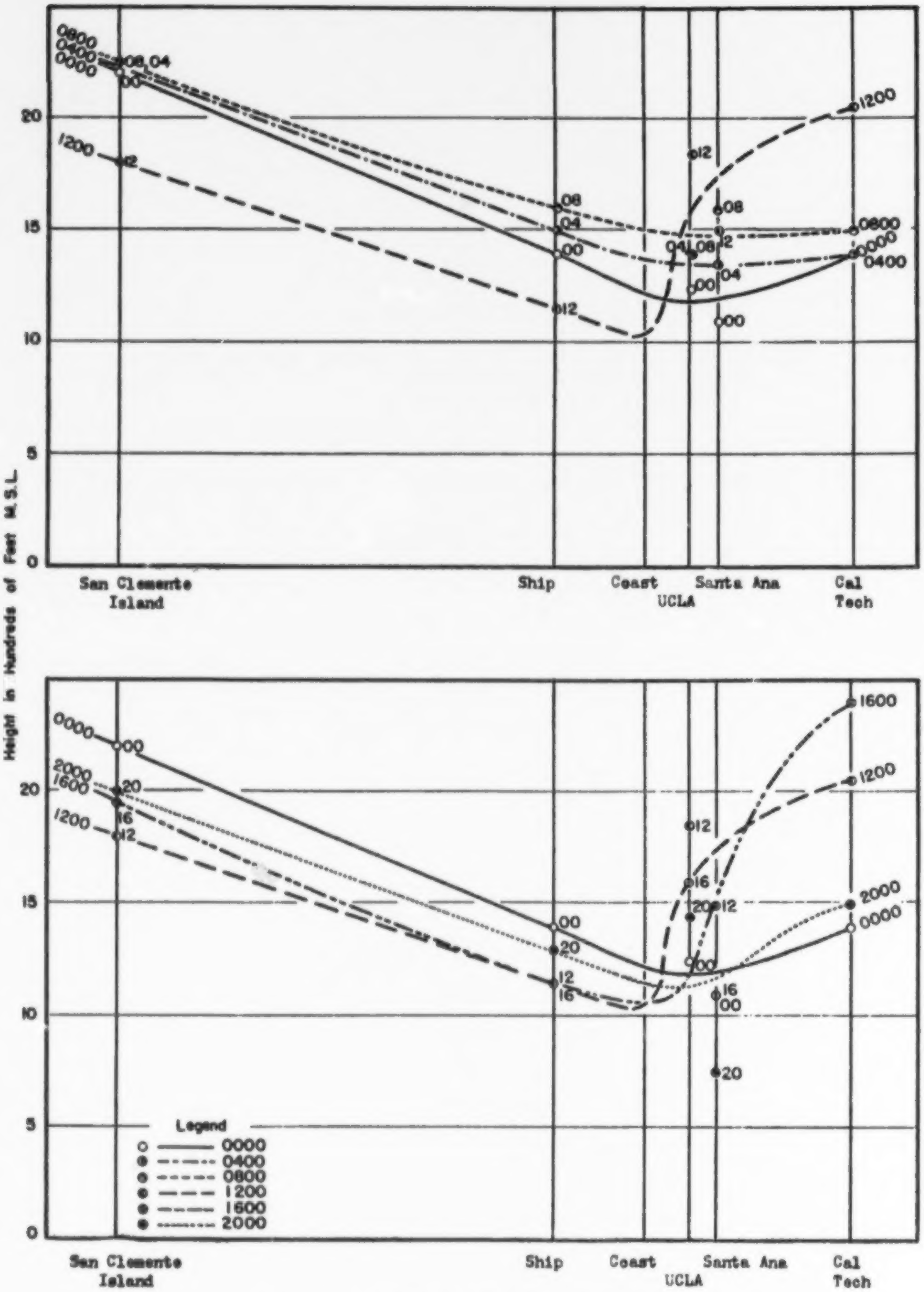
** Shading is for clarity only.

Figure 43


Radiosonde Sites
TZM - Santa Maria
PUC - UCLA
DUA - Pasadena (Cal Tech)
DSW - Santa Ana
NGA - San Clemente Island
NZY - North Island
0 10 20
Miles
1200
1200
1200
TZM 1000 1500
1400
Goleta 1000 1650
1000
1200
1400
1800
1600
2000
DUA 1700 2350
PUC 1500 2100
1200
1600
1400
1800
1600
2000
DSW 1250 1800
El Toro 1550 2000
Ship 1350
NGA 1650* 1950
NZY 1450 1900
Legend
Period of Ship Observation 1500
Month of September 2000
* Adjusted to Entire Ship Period
Contour Lines in Feet Above M.S.L.
Ship observations are for two 7-day periods.

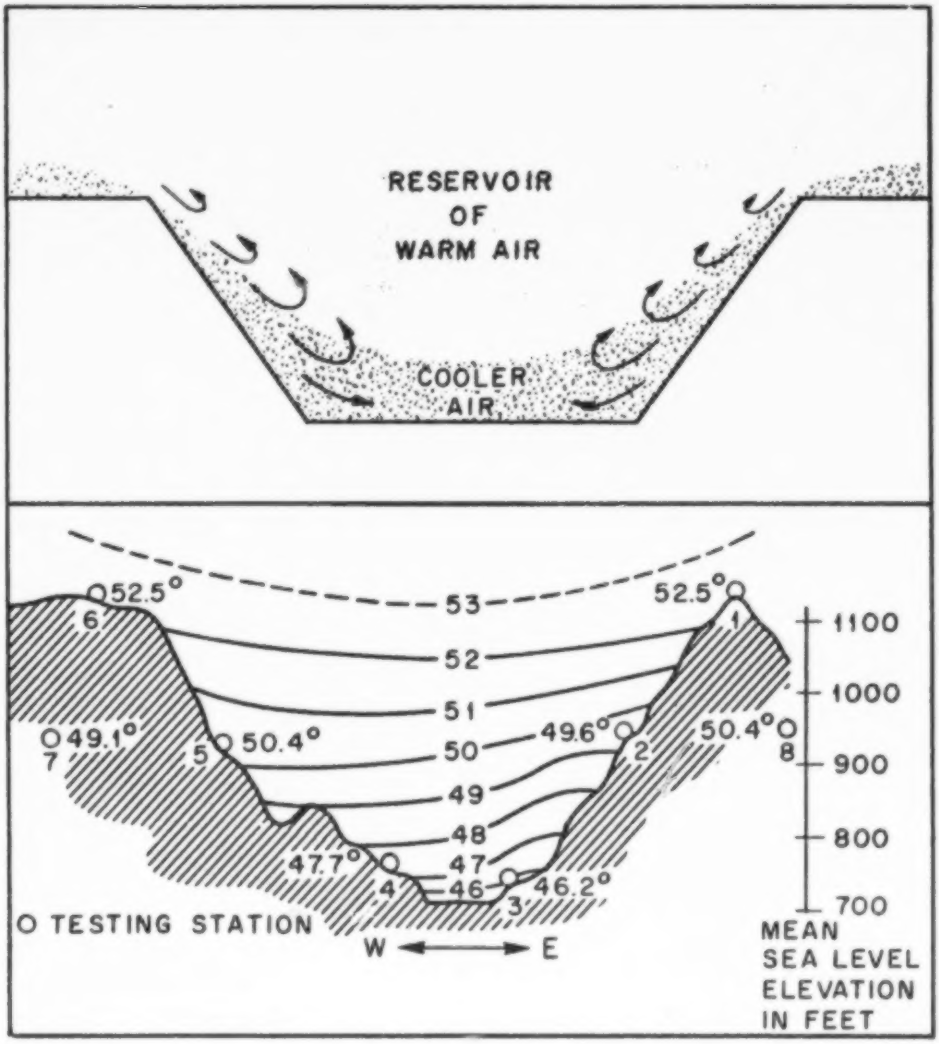
Contour Map of Inversion Base During Summertime
(after Neiburger, Beer and Leopold (2))

Figure 44



Average Profiles of Inversion Base
From Ocean Inland During Summertime
(After Neiburger, Beer and Leopold (2))

Figure 45

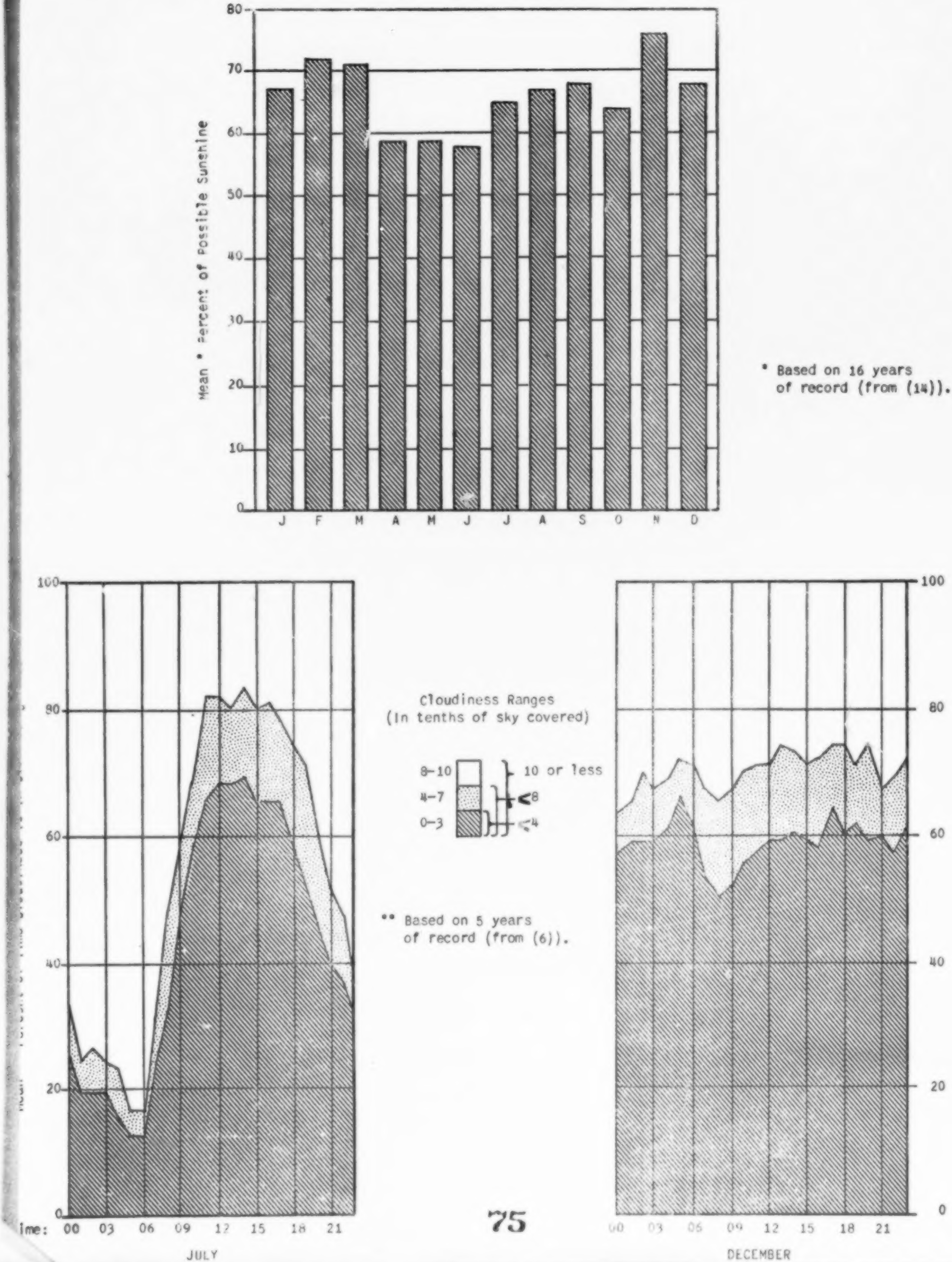

RESERVOIR OF WARM AIR
COOLER AIR
53
52
51
50
49
48
47
46
52.5°
52.5°
6
1
49.1°
7
50.4°
5
49.6°
2
50.4°
8
47.7°
4
46.2°
3
1100
1000
900
800
700
O TESTING STATION
W ← → E
MEAN SEA LEVEL ELEVATION IN FEET

TOP - Manner in which cold air drains into a valley.

BOTTOM - An observed temperature inversion resulting from cold air drainage (after Hoecker(5)).

Figure 46

SUNSHINE AND CLOUDINESS, LINDBERGH FIELD



* Based on 16 years of record (from (14)).

** Based on 5 years of record (from (6)).

Table 1

PERCENTAGE FREQUENCIES[1] OF WIND DIRECTION AND SPEED
LINDBERGH FIELD, 1949-1954

DIRECTION	JULY						DIRECTION	DECEMBER					
	Speed (miles/hour)							Speed (miles/hour)					
	0-3	4-7	8-12	>12	Total	Average Speed		0-3	4-7	8-12	>12	Total	Average Speed
N	3	4	+		7	4.2	N	8	4	1		13	3.5
NNE	2	3			5	4.1	NNE	3	3	1		7	4.5
NE	2	2			4	3.5	NE	5	3	1		9	3.9
ENE	+	+			1	3.4	ENE	2	1	+		3	4.7
E	+	+			1	2.8	E	4	3	+		7	3.9
ESE	+				+	2.8	ESE	2	2	+		4	4.3
SE	+	+	+		1	4.4	SE	2	1	1		4	4.8
SSE	+	1	1		2	6.3	SSE	1	1	1	+	3	6.7
S	1	4	2	+	7	6.5	S	2	2	1	1	6	6.0
SSW	1	7	6	+	13	7.3	SSW	1	1	1	1	4	6.7
SW	1	6	5	+	12	7.1	SW	2	3	1	+	6	5.4
WSW	1	4	4	+	8	7.1	WSW	1	2	1	+	4	6.4
W	1	5	4	1	10	7.3	W	2	3	2	+	7	6.9
WNW	1	6	7	+	14	7.9	WNW	+	2	3	+	7	9.0
NW	1	5	4	+	10	6.8	NW	1	3	3	1	8	7.1
NNW	1	4	1		6	5.2	NNW	2	2	1	1	6	5.7
CALM	+				+		CALM	4				4	
Total	15	50	33	2	100	6.5	Total	41	36	19	4	100	5.2

[1] Based on hourly observations. Values are to nearest whole percent not adjusted to make sums equal to total percentages.

+ Indicates more than 0 but less than 0.5.

Table 2

FREQUENCY OF WIND SPEED PERSISTENCE
LINDBERGH FIELD
AUGUST, 1949-JULY, 1954

MONTH	NUMBER OF HOURS														
	SPD	3	6	9	12	15	18	24	30	36	48	60	72	84	96	GR
January	0	9														3
	3	360	117	48	26	12	2									18
	7	818	363	211	128	100	79	14	8	8						46
	12	1,141	562	362	271	215	175	126	99	79	56	41	33	24	19	737
February	0	15	3	2	1											14
	3	304	96	37	22	4										17
	7	749	332	195	122	98	67	8	4	4						45
	12	1,053	515	333	240	188	156	102	79	62	41	30	23	19	15	277
March	0	11	2													7
	3	207	62	25	11	2										16
	7	673	288	159	110	100	43									23
	12	1,075	512	332	234	185	154	96	73	61	42	27	18	16	15	208
April	0	2														4
	3	122	29	12	4											14
	7	618	254	140	98	71	23									21
	12	1,069	511	328	231	187	150	85	66	54	33	23	14	13	9	351
May	0															2
	3	107	24	7	3											12
	7	603	255	127	102	62	12									21
	12	1,093	518	328	227	186	149	78	57	46	23	19	14	11	7	258
June	0															2
	3	73	13	3												11
	7	596	247	129	105	60	8									21
	12	1,106	533	341	241	195	159	94	71	59	38	31	23	16	13	937
July	0															2
	3	77	12	1												9
	7	678	292	154	124	71	17									22
	12	1,191	584	383	274	222	179	117	97	71	47	38	22	19	14	351
August	0															2
	3	112	25	6												10
	7	730	310	171	132	93	21	2								27
	12	1,169	565	372	256	214	176	102	85	67	41	32	23	20	15	381
September	0															2
	3	157	42	14	4	1										15
	7	762	332	186	136	108	42	1								25
	12	1,147	559	370	259	210	177	112	89	73	48	36	30	26	17	336
October	0	8														4
	3	260	82	40	18	6	1									18
	7	809	354	209	131	113	70	1	1	1						40
	12	1,164	572	375	269	217	181	119	92	79	48	34	28	22	15	309
November	0	14	1													7
	3	321	100	43	22	15	3									18
	7	865	389	241	138	117	97	13	8	7	2					50
	12	1,149	566	372	274	218	182	129	102	84	61	45	36	30	26	492
December	0	6														3
	3	368	120	55	29	16	2									18
	7	864	387	239	144	122	94	17	10	7	4	2				67
	12	1,180	578	377	282	221	180	129	105	85	58	46	38	31	23	395

SPD = Speed (in miles/hour) equal to or less than, for which wind persisted.

GR = Greatest number of hours for which speeds persisted.

Table 3

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
JANUARY, 1951-1954, 1956

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	>9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	84	32	25	19	8	4	36	13	10	8	13
25 - 500	3	2	0	1	0	3	0	0	0	0	0
501 - 1000	4	1	0	1	2	0	1	1	1	0	1
1001 - 1500	4	2	0	2	0	1	0	1	1	1	0
1501 - 2000	2	1	1	0	0	1	1	0	0	0	0
2001 - 2500	3	1	2	0	0	0	1	1	1	0	0
2501 - 3000	4	2	2	0	0	2	1	0	0	1	0
3001 - 3500	0	0	0	0	0	0	0	0	0	0	0
3501 - 5000	5	2	3	0	0	1	2	1	0	0	1
None	38										
Missing	8										
Total	155	43	33	23	10	12	42	17	13	10	15

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	>9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	34	14	15	5	0	2	9	10	5	5	3
25 - 500	4	2	2	0	0	0	1	0	1	2	0
501 - 1000	15	8	6	1	0	5	3	4	1	0	2
1001 - 1500	13	9	3	1	0	1	4	3	1	2	2
1501 - 2000	9	5	4	0	0	3	3	0	1	2	0
2001 - 2500	3	0	3	0	0	1	2	0	0	0	0
2501 - 3000	5	4	0	1	0	0	2	2	0	1	0
3001 - 3500	1	0	0	1	0	0	1	0	0	0	0
3501 - 5000	7	5	2	0	0	7	0	0	0	0	0
None	57										
Missing	7										
Total	155	47	35	9	0	19	25	19	9	12	7

Table 4

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
FEBRUARY, 1951-1954, 1956

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	77	26	23	15	13	9	23	20	13	6	6
25 - 500	2	2	0	0	0	1	1	0	0	0	0
501 - 1000	6	1	2	3	0	0	2	3	0	1	0
1001 - 1500	3	3	0	0	0	0	1	0	1	1	0
1501 - 2000	5	1	1	1	2	1	0	2	0	2	0
2001 - 2500	4	2	0	2	0	1	2	0	1	0	0
2501 - 3000	0	0	0	0	0	0	0	0	0	0	0
3001 - 3500	3	1	2	0	0	0	1	1	1	0	0
3501 - 5000	6	1	3	2	0	2	3	1	0	0	0
None	31										
Missing	5										
Total	142	37	31	23	15	14	33	27	16	10	6

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	26	14	7	3	2	0	7	9	7	1	2
25 - 500	1	0	0	0	1	0	0	1	0	0	0
501 - 1000	16	9	4	2	1	2	9	3	2	0	0
1001 - 1500	12	7	3	1	1	2	5	5	0	0	0
1501 - 2000	3	2	0	1	0	1	1	1	0	0	0
2001 - 2500	5	1	2	2	0	2	2	1	0	0	0
2501 - 3000	3	3	0	0	0	0	2	0	1	0	0
3001 - 3500	4	3	1	0	0	2	0	1	1	0	0
3501 - 5000	3	2	1	0	0	2	1	0	0	0	0
None	61										
Missing	8										
Total	142	41	18	9	5	11	27	21	11	1	2

Table 5

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
MARCH, 1951-1954, 1956

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	39	14	14	11	0	5	12	8	5	4	5
25 - 500	9	3	2	4	0	1	3	2	2	0	1
501 - 1000	9	1	5	2	1	1	3	3	1	0	1
1001 - 1500	7	0	2	4	1	0	1	3	3	0	0
1501 - 2000	6	0	3	3	0	0	1	3	2	0	0
2001 - 2500	11	2	4	3	2	3	3	2	1	1	1
2501 - 3000	7	3	2	2	0	1	1	3	2	0	0
3001 - 3500	3	1	2	0	0	0	2	1	0	0	0
3501 - 5000	12	7	4	1	0	1	6	5	0	0	0
None	41										
Missing	11										
Total	155	31	38	30	4	12	32	30	16	5	8

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	21	13	7	1	0	1	4	4	7	4	1
25 - 500	7	6	1	0	0	0	4	0	2	0	1
501 - 1000	16	6	5	5	0	2	6	2	3	3	0
1001 - 1500	11	8	2	1	0	5	2	3	0	0	1
1501 - 2000	10	3	6	1	0	4	2	2	1	1	0
2001 - 2500	7	5	1	1	0	2	3	0	0	2	0
2501 - 3000	7	6	1	0	0	1	2	1	1	2	0
3001 - 3500	3	1	1	1	0	0	2	1	0	0	0
3501 - 5000	9	7	2	0	0	5	2	2	0	0	0
None	49										
Missing	15										
Total	155	55	26	10	0	20	27	15	14	12	3

Table 6

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
APRIL, 1951-1954, 1956

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	3	0	1	2	0	0	0	1	0	0	2
25 - 500	5	1	1	1	2	1	0	1	2	1	0
501 - 1000	9	0	3	2	4	0	1	2	4	2	0
1001 - 1500	11	4	2	4	1	4	3	2	2	0	0
1501 - 2000	13	2	1	5	5	2	3	1	4	3	0
2001 - 2500	21	2	11	6	2	4	3	6	4	1	3
2501 - 3000	14	5	3	2	4	3	4	4	1	2	0
3001 - 3500	13	6	3	3	1	1	2	3	7	0	0
3501 - 5000	20	11	6	3	0	7	10	3	0	0	0
None	38										
Missing	3										
Total	150	31	31	28	19	22	26	23	24	9	5

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	2	0	0	2	0	0	0	0	2	0	0
25 - 500	3	1	1	0	1	0	1	0	0	0	2
501 - 1000	14	6	5	0	3	0	3	1	5	3	2
1001 - 1500	23	2	11	6	4	3	5	6	2	5	2
1501 - 2000	18	10	1	5	2	4	6	5	2	0	1
2001 - 2500	11	2	3	5	1	2	1	2	3	3	0
2501 - 3000	11	6	1	3	1	1	5	2	3	0	0
3001 - 3500	8	5	2	1	0	2	3	3	0	0	0
3501 - 5000	13	10	3	0	0	4	4	5	0	0	0
None	39										
Missing	8										
Total	150	42	27	22	12	16	28	24	17	11	7

Table 7

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
May, 1950-1954

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	5	1	4	0	0	0	3	1	0	0	1
25 - 500	3	0	2	1	0	1	1	0	1	0	0
501 - 1000	8	1	5	2	0	0	0	2	4	2	0
1001 - 1500	24	10	3	6	5	2	4	5	2	7	4
1501 - 2000	24	6	2	7	9	0	9	2	8	2	3
2001 - 2500	22	2	4	8	8	2	3	8	4	5	0
2501 - 3000	15	4	3	6	2	2	4	2	6	1	0
3001 - 3500	16	3	3	8	2	2	3	7	2	1	1
3501 - 5000	17	4	3	9	1	5	7	2	1	2	0
None	14										
Missing	7										
Total	155	31	29	47	27	14	34	29	28	20	9

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	3	2	1	0	0	0	3	0	0	0	0
25 - 500	5	1	2	2	0	0	0	0	1	2	2
501 - 1000	23	9	6	6	2	4	5	5	2	3	4
1001 - 1500	29	9	11	3	6	6	5	8	3	2	5
1501 - 2000	26	6	5	7	8	1	4	4	7	2	8
2001 - 2500	20	3	6	6	5	1	2	0	5	4	8
2501 - 3000	9	3	3	1	2	1	1	3	1	2	1
3001 - 3500	6	1	2	2	1	0	1	3	2	0	0
3501 - 5000	12	5	3	4	0	2	5	2	1	2	0
None	18										
Missing	4										
Total	155	39	39	31	24	15	26	25	22	17	28

Table 8

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
JUNE, 1950-1953, 1956

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	1	0	0	0	1	0	0	0	0	1	0
25 - 500	3	1	1	1	0	0	0	0	1	0	2
501 - 1000	13	0	3	3	7	0	0	1	3	5	4
1001 - 1500	20	0	7	4	9	1	3	4	3	6	3
1501 - 2000	24	0	4	9	11	1	1	5	6	7	4
2001 - 2500	14	0	3	4	7	2	1	4	1	1	5
2501 - 3000	18	2	7	7	2	2	5	1	4	6	0
3301 - 3500	15	2	7	5	1	2	2	5	5	1	0
3001 - 5000	17	5	4	7	1	3	8	3	0	1	2
None	7										
Missing	18										
Total	150	10	36	40	39	11	20	23	23	28	20

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	2	1	1	0	0	0	0	0	1	0	1
25 - 500	2	0	1	1	0	0	0	0	0	0	2
501 - 1000	24	2	7	5	10	1	4	2	3	2	12
1001 - 1500	28	5	7	7	9	0	3	3	7	4	11
1501 - 2000	26	3	13	5	5	3	6	6	1	4	6
2001 - 2500	18	3	6	7	2	0	3	4	1	5	5
2501 - 3000	11	4	2	3	2	1	1	0	2	5	2
3001 - 3500	6	0	6	0	0	1	0	3	2	0	0
3501 - 5000	11	3	6	2	0	3	2	4	1	1	0
None	1										
Missing	21										
Total	150	21	49	30	28	9	19	22	18	21	39

Table 9

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
JULY, 1950-1953, 1956*

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	4	0	4	0	0	0	1	0	1	2	0
25 - 500	7	2	2	3	0	0	0	1	1	0	5
501 - 1000	15	1	4	6	4	0	2	2	4	3	4
1001 - 1500	43	0	9	14	20	1	2	6	17	9	8
1501 - 2000	45	1	5	18	21	1	9	11	9	5	10
2001 - 2500	14	0	0	4	10	1	3	2	3	2	3
2501 - 3000	11	0	2	4	5	1	2	0	4	1	3
3001 - 3500	5	0	0	4	1	1	1	0	2	1	0
3501 - 5000	2	0	0	1	1	0	2	0	0	0	0
None	1										
Missing	8										
Total	155	4	26	54	62	5	22	22	41	23	33

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	7	0	5	0	2	0	0	0	1	3	3
25 - 500	14	1	6	3	4	1	1	1	3	3	5
501 - 1000	38	4	11	16	7	2	3	4	6	8	15
1001 - 1500	54	1	10	32	11	0	0	7	14	11	22
1501 - 2000	25	0	8	4	13	0	1	7	4	5	8
2001 - 2500	8	0	1	5	2	0	2	0	0	5	1
2501 - 3000	1	0	1	0	0	0	0	1	0	0	0
3001 - 3500	0	0	0	0	0	0	0	0	0	0	0
3501 - 5000	1	0	1	0	0	0	0	1	0	0	0
None	0										
Missing	7										
Total	155	6	43	60	39	3	7	21	28	35	54

*Data for this year from Montgomery Field.

Table 10

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
AUGUST, 1950-1953, 1955

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	4	1	0	1	2	0	0	1	1	0	2
25 - 500	5	0	1	2	2	0	1	1	0	1	2
501 - 1000	25	3	5	11	6	1	3	5	5	4	7
1001 - 1500	45	0	3	11	31	2	6	8	10	10	9
1501 - 2000	33	0	2	13	18	2	8	4	10	5	4
2001 - 2500	17	0	1	3	13	0	1	2	5	6	3
2501 - 3000	4	0	1	1	2	0	1	0	1	2	0
3001 - 3500	2	0	1	1	0	0	1	1	0	0	0
3501 - 5000	2	2	0	0	0	0	1	1	0	0	0
None	4										
Missing	14										
Total	155	6	14	43	74	5	22	23	32	28	27

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	3	1	0	1	1	1	1	0	0	0	1
25 - 500	14	1	4	4	5	1	1	3	4	2	3
501 - 1000	57	1	15	24	17	4	6	8	13	15	11
1001 - 1500	47	1	7	23	16	0	4	10	12	11	10
1501 - 2000	20	1	3	7	9	0	2	3	3	6	6
2001 - 2500	5	0	2	1	2	0	1	0	2	1	1
2501 - 3000	2	1	0	0	1	0	1	1	0	0	0
3001 - 3500	3	1	2	0	0	1	0	0	2	0	0
3501 - 5000	0	0	0	0	0	0	0	0	0	0	0
None	1										
Missing	3										
Total	155	7	33	60	51	7	16	25	36	35	32

Table 11

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
SEPTEMBER, 1950-1953, 1955

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	21	0	6	7	8	0	1	4	6	5	5
25 - 500	17	0	6	4	7	1	1	5	3	4	3
501 - 1000	18	1	1	5	11	0	4	3	7	1	3
1001 - 1500	21	1	2	3	15	1	2	3	7	2	6
1501 - 2000	26	3	0	11	12	1	5	5	10	2	3
2001 - 2500	13	3	2	4	4	1	3	3	2	2	2
2501 - 3000	9	0	6	3	0	1	3	3	1	1	0
3001 - 3500	8	1	4	3	0	2	5	0	0	1	0
3501 - 5000	7	2	1	4	0	1	3	3	0	0	0
None	2										
Missing	8										
Total	150	11	28	44	57	8	27	29	36	18	22

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	26	7	7	8	4	0	0	8	6	6	6
25 - 500	17	0	3	6	8	0	1	1	4	2	9
501 - 1000	28	1	7	12	8	1	0	6	5	6	10
1001 - 1500	31	2	4	16	9	2	1	9	4	6	9
1501 - 2000	22	4	7	6	5	4	0	8	5	3	2
2001 - 2500	11	2	7	1	1	1	4	2	3	1	0
2501 - 3000	5	0	4	1	0	0	2	2	1	0	0
3001 - 3500	4	1	3	0	0	0	2	2	0	0	0
3501 - 5000	2	1	1	0	0	1	1	0	0	0	0
None	2										
Missing	2										
Total	150	18	43	50	35	9	11	38	28	24	36

Table 12

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
OCTOBER, 1950-1953, 1955

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	37	5	11	14	7	3	6	9	9	4	6
25 - 500	10	1	1	3	5	0	3	4	0	1	2
501 - 1000	14	0	5	2	7	1	4	1	5	0	3
1001 - 1500	24	1	0	7	16	2	4	7	7	3	1
1501 - 2000	22	1	1	8	12	1	3	11	3	4	0
2001 - 2500	16	3	2	6	5	3	3	5	2	2	1
2501 - 3000	6	2	1	1	2	1	2	0	1	1	1
3001 - 3500	7	3	2	2	0	0	3	1	3	0	0
3501 - 5000	8	5	2	1	0	4	2	1	1	0	0
None	7										
Missing	4										
Total	155	21	25	44	54	15	30	39	31	15	14

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C). top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	25	13	7	3	2	6	3	7	5	2	2
25 - 500	13	1	2	7	3	1	2	4	3	2	1
501 - 1000	29	3	10	8	8	2	4	8	13	1	1
1001 - 1500	35	7	9	11	8	6	4	9	11	3	2
1501 - 2000	16	3	4	5	4	3	1	3	3	3	3
2001 - 2500	11	3	1	7	0	0	3	3	1	0	4
2501 - 3000	5	0	4	0	1	1	1	1	1	1	0
3001 - 3500	4	2	1	1	0	2	1	1	0	0	0
3501 - 5000	3	2	1	0	0	1	1	1	0	0	0
None	10										
Missing	4										
Total	155	34	39	42	26	22	20	37	37	12	13

Table 13

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
NOVEMBER, 1950-1954

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	66	21	20	19	6	9	18	12	15	3	9
25 - 500	12	0	6	3	3	2	0	3	5	0	2
501 - 1000	5	0	1	1	3	0	0	2	2	0	1
1001 - 1500	10	1	3	0	6	0	1	5	1	2	1
1501 - 2000	4	2	2	0	0	2	0	0	1	0	1
2001 - 2500	3	2	0	0	1	0	1	2	0	0	0
2501 - 3000	5	2	3	0	0	3	1	1	0	0	0
3001 - 3500	4	2	1	1	0	2	0	1	1	0	0
3501 - 5000	6	2	1	3	0	1	5	0	0	0	0
None	22										
Missing	13										
Total	150	32	37	27	19	19	26	26	25	5	14

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	36	18	10	5	3	5	9	11	6	5	0
25 - 500	11	4	3	4	0	1	1	5	2	1	1
501 - 1000	14	6	2	5	1	0	5	2	2	2	3
1001 - 1500	13	7	2	3	1	2	5	3	0	0	3
1501 - 2000	14	8	4	2	0	4	1	5	2	1	1
2001 - 2500	5	4	1	0	0	2	2	1	0	0	0
2501 - 3000	5	5	0	0	0	1	2	1	1	0	0
3001 - 3500	3	3	0	0	0	2	1	0	0	0	0
3501 - 5000	4	3	1	0	0	2	1	1	0	0	0
None	34										
Missing	11										
Total	150	58	23	19	5	19	27	29	13	9	8

Table 14

TEMPERATURE INVERSION CHARACTERISTICS - FREQUENCY OF OCCURRENCE
N.A.S. NORTH ISLAND
DECEMBER, 1950-1953, 1955

0700 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	89	40	20	21	8	9	33	16	17	5	9
25 - 500	0	0	0	0	0	0	0	0	0	0	0
501 - 100	6	1	4	1	0	1	2	2	1	0	0
1001 - 1500	6	2	0	3	1	1	2	2	1	0	0
1501 - 2000	6	2	2	2	0	2	1	1	1	1	0
2001 - 2500	2	0	1	1	0	0	0	1	0	1	0
2501 - 3000	1	0	1	0	0	0	1	0	0	0	0
3001 - 3500	5	1	2	2	0	4	1	0	0	0	0
3501 - 5000	10	5	5	0	0	4	5	1	0	0	0
None	22										
Missing	8										
Total	155	51	35	30	9	21	45	23	20	7	9

1900 PST OBSERVATIONS

HEIGHT OF INVERSION BASE, (feet)	FREQUENCY	INVERSION LAYER									
		Temperature Difference (°C), top minus base				Thickness (feet) Height of top minus height of base					
		0-3	4-6	7-9	> 9	0 - 500	501-1000	1001-1500	1501-2000	2001-2500	> 2500
Surface (24)	44	23	14	5	2	3	12	15	8	1	5
25 - 500	5	4	0	1	0	1	3	1	0	0	0
501 - 100	14	8	5	1	0	5	6	2	0	0	1
1001 - 1500	9	6	1	2	0	2	2	2	2	1	0
1501 - 2000	3	1	2	0	0	1	0	1	0	1	0
2001 - 2500	5	2	3	0	0	1	2	1	0	0	1
2501 - 3000	8	8	0	0	0	2	4	2	0	0	0
3001 - 3500	6	5	0	1	0	1	2	2	1	0	0
3501 - 5000	9	9	0	0	0	4	2	2	0	0	1
None	38										
Missing	14										
Total	155	66	25	10	2	20	33	28	11	3	8

Table 15
INVERSION OBSERVATIONS AND EFFECTS OF SURFACE HEATING
MAY 1950 - APRIL 1951

OBSERVATIONS	1951				1950							
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Island (24 feet elevation)												
Average height of base, 0700 PST (feet)	595	395	1289	2643	2603	2451	1609	1568	2019	1208	497	521
Average height of base, 1900 PST (feet)	864	798	1615	2231	2447	1881	1396	1208	1709	1016	849	788
Number of days 1900 PST base at or below 0700 PST base	5	7	7	10	14	24	19	18	15	18	12	16
Number of days inversion observed at 0700 and 1900 PST	10	11	13	14	25	29	29	26	28	27	22	23
COMPUTATIONS FROM MAXIMUM SURFACE TEMPERATURE												
Lindbergh Field (19 feet elevation)												
Average height of base (feet)	1838	1540	2529	2693	2831	2203	1947	1609	2197	1656	1540	1673
Number of days 1900 PST inversion wiped out	1	3	4	2	5	0	1	0	1	2	5	6
Number of days base at or between 0700 and 1900 PST heights	2	0	3	6	14	23	7	12	13	4	5	3
Number of days base above 0700 and 1900 PST heights	7	9	6	7	8	6	21	14	14	21	13	14
Bonita (110 feet elevation)												
Average height of base (feet)	2371	2111	3032	2971	3052	2397	2232	1934	2535	1926	1883	2353
Number of days 1900 PST inversion wiped out	5	5	5	2	11	0	1	1	2	6	9	13
Number of days base at or between 0700 and 1900 PST heights	0	0	2	5	10	17	4	9	9	3	2	3
Number of days base above 0700 and 1900 PST heights	7	6	6	8	6	12	24	17	17	18	12	7
El Cajon (540 feet elevation)												
Average height of base (feet)	2053	3600	3740	3412	3453	3135	3108	2738	3094	2522	2073	3258
Number of days 1900 PST inversion wiped out	9	10	11	4	12	9	7	10	12	18	20	20
Number of days base at or between 0700 and 1900 PST heights	0	0	0	3	5	3	1	1	3	1	1	0
Number of days base above 0700 and 1900 PST heights	3	1	4	8	10	17	22	19	13	8	2	3
Ramona (1474 feet elevation)												
Average height of base (feet)	-	3950	4650	3970	4096	4288	4462	3844	3880	4400	2700	4000
Number of days 1900 PST inversion wiped out	12	10	14	9	16	16	23	22	23	26	22	22
Number of days base at or between 0700 and 1900 PST heights	0	0	0	1	1	1	0	0	0	0	0	0
Number of days base above 0700 and 1900 PST heights	0	1	1	6	10	12	7	8	5	1	1	2

END